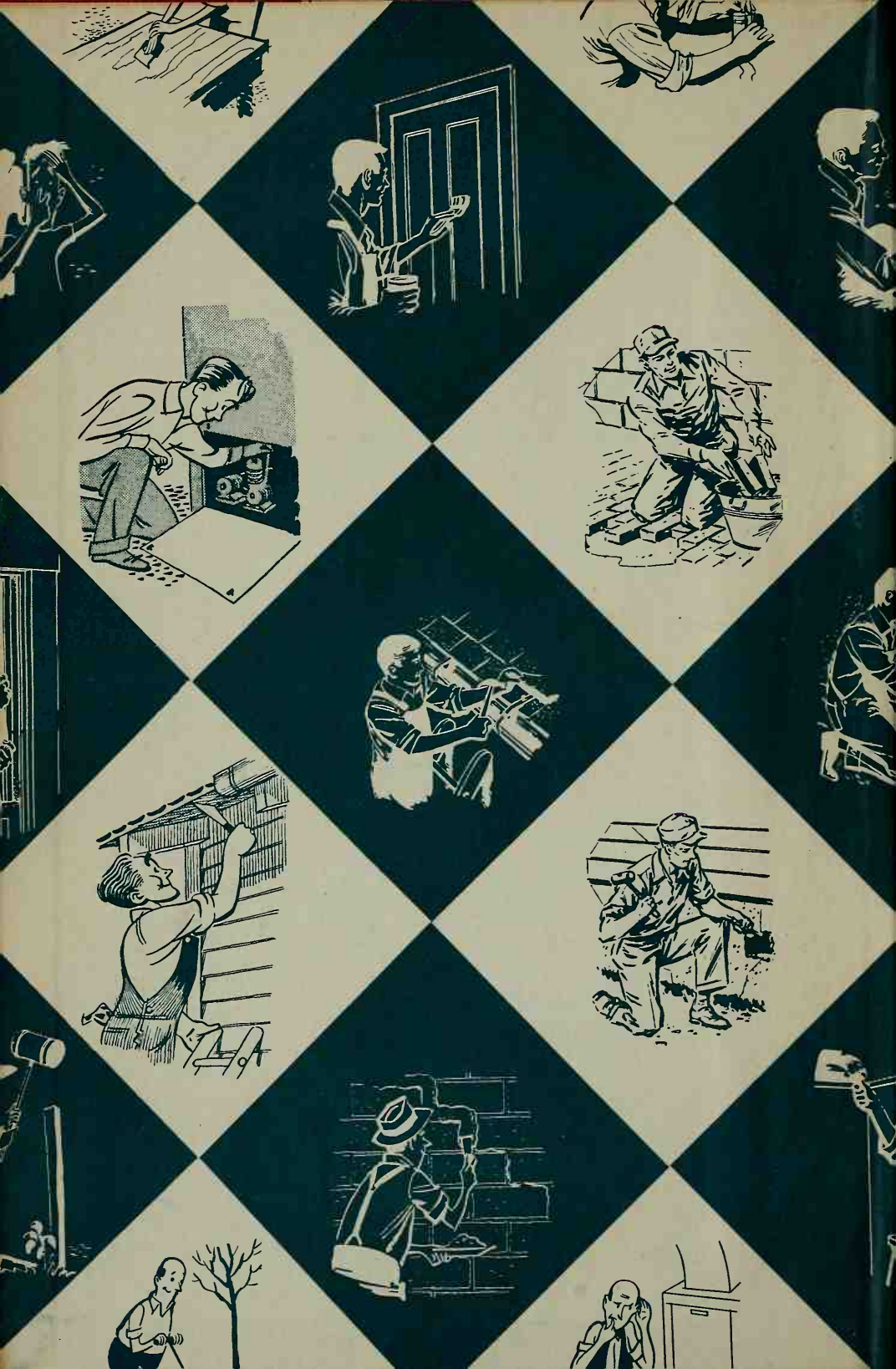








**POPULAR
MECHANICS
DO-IT-YOURSELF
ENCYCLOPEDIA**

POPULAR MECHANICS DO-IT-YOURSELF ENCYCLOPEDIA

FOR
HOME OWNER, CRAFTSMAN
AND HOBBYIST
IN TWELVE VOLUMES



Volume XI

Complete Index in Volume XII

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Simple TELEVISION

Repairs



TELEVISION installation and service were for a long time considered as things to be attempted only by the skilled technician. And, for a shorter period of time, many dealers regarded the installation of a television receiver they sold as a prerogative they should insist upon in order to make sure that the set operated satisfactorily and the customer was pleased by the service rendered.

Now, however, the picture has altered considerably. More and more television sets are sold at low cost, which leaves the dealer with no margin to use for such services as free installation and checkups.

After a few hardy souls showed the way, the erection of television antennas by rank amateurs became common. More recently, many set owners have undertaken to save themselves the relatively high costs of servicing. Some are successful, and some are not.

There is no reason why any television owner cannot perform many, if not most, service and replacement needs on his set. However, in order to do anything successfully, it is very desirable to know just a little bit about *what* you are doing. In this chapter the television receiver in general—and no one make or model in particular—is described by sections so that you can perform various operations on your receiver and know to some extent *what* you are doing and *why*.

There are a number of reasons why home television service is quite practical. Most important is the fact that the greatest majority of difficulties arise from the simple failure of one or more of the small vacuum tubes. Certain of these tubes cause definite effects on the face of the tube when they fail. Thus, by noting what the picture is—or is not—doing, the owner can determine the part of the circuit in which the trouble lies. Once this is determined, the simplest way to correct the trouble is to replace the defective part.

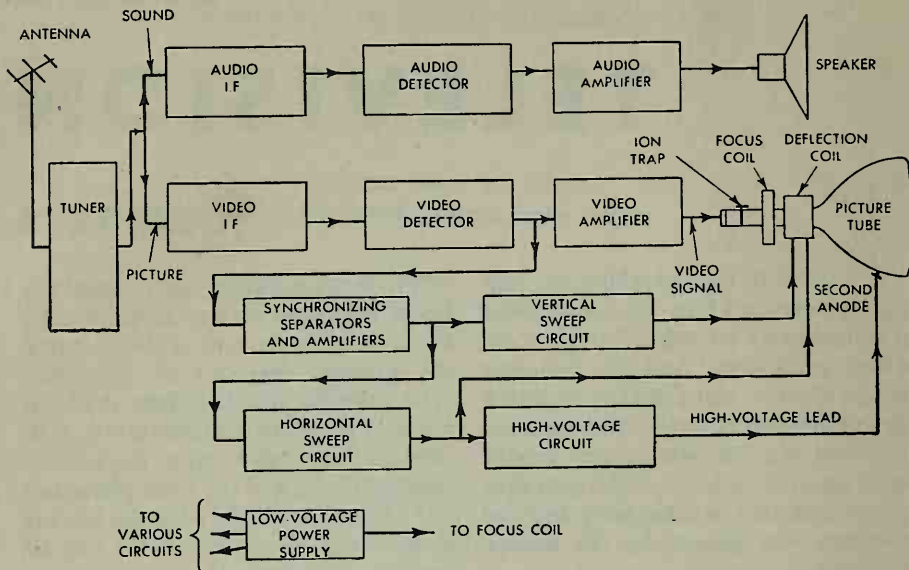
Know Your Circuit Layout

A block diagram of a typical television receiver is shown. This diagram is not of any one set, but a composite which shows the basic circuits, their functions and their relationship to other circuits and parts of the set.

Most television manufacturers have laid out diagrams for their particular sets for the convenience of servicemen. It may be possible for you to obtain one of these from the manufacturer of your set or from a dealer.

On the back of your receiver you will find a perforated cover. This cover is there to seal in the extremely high voltages present inside, and is perforated to provide ventilation for the heat generated in the set. A plug on the cover in turn plugs into a two-prong socket in the set. When the cover is removed, the circuit is broken

BLOCK DIAGRAM OF TYPICAL TV RECEIVER



and the receiver cannot be turned on. This device is called a "safety interlock."

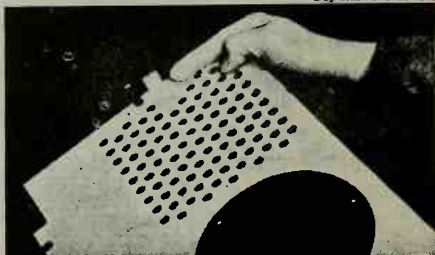
Never take this cover off until you have learned where the high-voltage danger points are located and how to avoid them. This is most important, and will be discussed in detail later. The high voltage in even a small 7-inch receiver is as great as 4500 volts, while the projection-type receiver found in most homes will go as high—and sometimes higher—than 27,000 volts! Voltages of these strengths should be treated with respect.

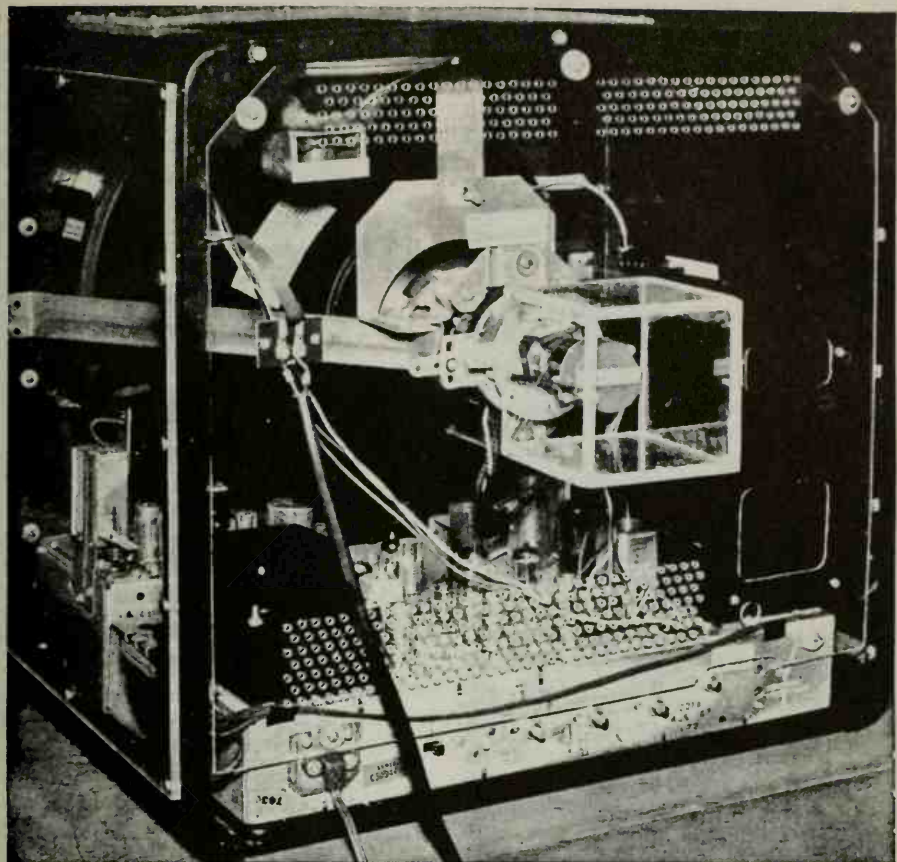
The parts that make up a television receiver—tubes, resistors, condensers, coils, wiring and sockets—are mounted on a metal base called the chassis. In some receivers all the parts, including the picture tube and the speaker, are mounted on one chassis. In others, the speaker has its own chassis; still others have the picture tube mounted separately, and some have different circuits

mounted on individual chassis. It is quite common to find the power transformer, rectifier tube, high-voltage tubes and transformer and damper tube mounted on one chassis—sometimes called the "power deck"—and the rest of the receiver mounted on another. In such cases the chassis are connected by cables which either join each other or plug into sockets mounted on the chassis themselves. In order to remove the receiver from the cab-

This is the safety interlock that cuts off the power when the back of the TV-receiver cabinet is removed

Popular Mechanics





Housed in clear plastic, this set shows mounting of tubes and parts

inet, it is often necessary to disconnect these cables. Before doing so, it is wise to mark each one and the socket into which it plugs so that the parts can be reassembled correctly.

It is not always necessary to remove the television receiver from the cabinet in order to replace tubes, and it should not be done if it can be helped. However, many receivers are mounted in such a way that it is impossible to replace certain tubes without at least removing the particular chassis to which that tube is connected. The high-voltage tubes, for example, are

usually enclosed by a metal shield which must be uncovered or removed before the tube can be replaced. Also, some of the miniature tubes used are located in such a position that more time is wasted trying to fit the tube prongs blindly than would be spent in removing and replacing the chassis.

Removing the Chassis

Certain definite steps should be followed when the television receiver is removed from the cabinet. These steps are enumerated here; if carefully followed there will be no shock hazard:

1. Turn off the set and pull the power cord out of the wall receptacle.
2. Remove the knobs from the front controls. These knobs generally are of the push-on type and can be removed quite easily. This must be done so that the shafts of the controls can be drawn through the holes in the front panel. Any special tools required to loosen set screws can be obtained cheaply at any radio-supply house.
3. Remove the back shield, which usually has the safety interlock riveted to it. This exposes the receiver and also completely disconnects the source of power. In some cases it will be necessary to disconnect the antenna before removing the back cover. Inasmuch as some receivers have antenna connections for either 300-ohm or 72-ohm leads, it is wise to make sure which one is being used before disconnecting any antenna lead.
4. Carefully inspect the chassis and determine how it is mounted. Usually they are held by bolts, fed through a wooden base or mounting, which screw into the corners of the metal chassis. In some receivers, ordinary wood screws are used. These bolts or screws should now be removed.
5. Check the speaker mounting and connection. Unless the speaker is mounted directly on the speaker chassis, it must be disconnected. Various forms of connections are used: Some speaker leads plug into a socket on the chassis, others plug into one end of a cable leading from a chassis.
6. Inspect the picture tube to see if it is mounted independently of any chassis or if it is mounted on the same chassis that holds the other parts of the receiver. If mounted independently, it must be disconnected in the same manner as the speaker. If this is necessary, more steps must be taken at this point. The high-voltage lead which plugs into the side of the tube should first be disconnected and grounded to one of the chassis. An illustration on page 28 shows how this is done. Be very careful not to touch the metal tip of the lead, as there is enough charge in the high-voltage condensers to give you quite a "nip." Grasp the lead firmly at the base of the rubber suction cup when handling the lead and disconnecting it. Next, disconnect any other cables which connect the picture-tube unit to the other chassis. The parts around the neck of the picture tube, with the exception of the ion trap, are fixed firmly and should not be removed when taking out the receiver. The tube socket is taken off. This socket is "keyed" to fit on the tube base only one way, so you need not worry about getting it back incorrectly. As a further precaution against shock, it would be wise at this time to short-circuit the high-voltage coating on the picture tube by placing a length of insulated wire between coating and chassis.
7. If the chassis in the receiver are all separately mounted, they should be disconnected at this time.
8. The receiver is now ready for removal. This should be done carefully and gently—first to make sure it has been disconnected properly, and secondly because the receiver is a fairly delicate instrument that cannot take too much bouncing and bumping.
9. Carefully reassemble the receiver. Be sure that all connections are together firmly and that a good contact is made. This applies especially to the high-voltage lead attached to the second anode on the side of the tube.
10. Inasmuch as the power cord and its safety plug are riveted to the perforated back cover of the set, it will be necessary to buy an extra one to operate the receiver while it is out of the cabinet. These can be obtained at any radio-supply house for less than a dollar.

Tuner Adjustment

The tuners of television receivers are all carefully adjusted before the sets are shipped from the factory. The tuning adjustments made on them are critical in the highest degree. Unless he is very well equipped with test instruments, even an experienced serviceman will make no attempt to adjust the tuning of this circuit because of its delicate balance.

There are but two repairs the home owner should attempt on the tuner section of his receiver. One is the replacement of defective tubes. The second is adjustment of the oscillator. The first is simply a matter of pulling out the defective tube and inserting a new one.

With few exceptions — notably the continuous-type tuners — the tuners used in television receivers have fine-tuning controls. These usually are found at the front end of the tuner-assembly shaft. The purpose is to enable the owner to tune sharply the station he selects. In this way he can compensate for changes in the values of condensers and resistors because of age or other factors, all of which alter the tuning of the receiver.

At times, however, no matter how the fine tuning is adjusted, the picture cannot be brought in clearly with good detail and contrast. Or, what is worse to some people, the sound and picture are not synchronized. Tuning in a good picture results in poor sound, and vice versa. Any of these can occur when the oscillator or mixer tubes are changed. The difficulty may show up gradually, indicating such wide changes in circuit component values that the fine-tuning control is no longer able to compensate. Under these circumstances, it is possible that the

oscillator can be adjusted to correct these troubles.

Oscillator Correction

Oscillators generally are tuned by varying the depth to which a brass or iron core is inserted in the hollow center of a coil.

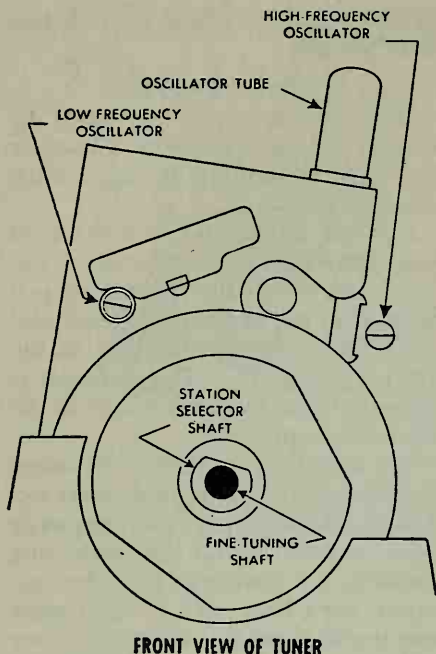
Inserted in the coil is a threaded brass slug with a screwdriver slot at the outer end. When the channel strip is inserted in the tuner, this slotted end can be seen through the hole in the tuner marked "H." The oscillator is adjusted while the set is tuned to the defective channel.

Because of the frequencies involved in radio and television, tuning any section which operates at radio frequency must be done with a nonconducting screwdriver. These can easily be purchased for a small sum, or it is quite easy to make one from a slender piece of wood. With such a tool, turn the slug in the oscillator coil slowly and carefully. Watch the picture and listen to the sound with equal attention. There will be a point at which both picture and sound are at their best. If this point gives satisfactory results, no further adjustment is necessary.

If the results still are unsatisfactory, the oscillator tube should be changed and a new one tried. If the trouble lies in the oscillator section because of mistuning or a defective oscillator tube, this adjustment will clarify the picture and give good, synchronized sound.

In the turret-type tuner there is a separate oscillator adjustment for each channel. The process outlined should be performed only for those which may be defective. The procedure, however, varies somewhat in tuners which do not have separate strips for each channel.

As a general rule, the adjustment



for the oscillator is found on the front end of the tuner. One type of tuner has only two oscillator adjustments, one for Channels 2 through 6 and the other for Channels 7 through 13. These are referred to as the "low-frequency oscillator" and the "high-frequency oscillator." Because of the variety of tuners used, it is impractical to show details of every type. For the location of oscillator-tuning adjustments, it is necessary to refer to the service diagram of your particular set.

An example of a switch-type tuner is shown. Notice the two screwdriver adjustments for oscillator tuning. In making adjustments for the low-frequency channels, any station in that band is selected and tuned in as best possible. The oscillator is then adjusted for picture and sound. The channel selector is then turned to another station in the low-frequency band and

the same procedure is followed, using the same oscillator-adjusting screw. Then return to the first channel. If the fine-tuning control cannot be adjusted to bring in the proper picture and sound, the oscillator slug should be retuned. Return to the second station and check. It may be necessary to repeat this procedure several times before settling on one position that satisfies the requirements of all the stations involved.

The steps to be followed in adjusting the oscillator for the high-frequency band are the same. Because of the higher frequencies, be more cautious in turning the slug.

Certain types of receiver employ a type of tuner which has replaceable channel strips other than those mentioned and illustrated. In these, it is frequently possible to purchase from the manufacturer a replacement part for an offending channel. This is necessary in those cases where there is no doubt that the strip itself is defective. Normally this is a task for a serviceman, but in localities where none is available the job can be done by a handyman.

Primary Controls

The primary controls of a television receiver are generally located at the front of the cabinet. These are the operating controls. They are:

Station or channel selector. By this means the station desired is selected. It controls the action of the tuner by putting into the circuit the proper r.f. amplifier circuit and oscillator circuit. As described previously in explaining the action of the tuner, the parts making up these circuits often change in value or adjustment. It is necessary to have some means of compensating for these changes. This is a function of the

Fine-tuning control. As a rule, the fine-tuning control and the channel selector are mounted on concentric shafts—that is, the shaft of the fine-tuning control is within that of the selector shaft. After the station desired is selected, it is brought into sharp detail by the fine-tuning control. This control is not found on continuous-tape tuners.

Volume control. This performs the same function in a television receiver as the volume control of a radio—it controls the amplitude level of the sound.

Brightness control. This governs the brilliance of the screen image. When the brightness control is varied, the difference in voltage between the grid and cathode of the picture tube is changed.

Contrast control. This governs the “volume” of the picture in much the same way as the volume control governs sound. In most sets the contrast control regulates the video i.f. stages; in others it controls the video amplifiers and occasionally it also controls the r.f. amplifier.

Vertical hold. Occasionally called the frame control or vertical-frequency control, the vertical hold keeps the vertical-sweep circuits operating at 60 cycles per second. The same comments that apply to the vertical hold are true of the horizontal hold. Often, the two controls are mounted concentrically. Like the horizontal hold, the vertical hold is sometimes mounted at the rear.

Horizontal hold. This is sometimes called the horizontal synchronizer, the synchrolock and the speed control.

Secondary Controls

Secondary, or nonoperating controls, are those which seldom need ad-

justment. They are usually mounted at the rear of the set or under a plate on the front panel.

Focus. The focus control is a current-regulating device. Varying the current passing through the focus coil changes the focal length of the electronic lens set up by the magnetic field. The focus control should be adjusted for the sharpest lines on the screen. This, like all image adjustments, should be done when the test pattern is being broadcast. One adjustment will satisfy focus requirements for all channels.

Width. This control is a coil or condenser which varies the operation of the secondary winding of the high-voltage transformer. Varying this control requires a screwdriver. Some require many turns before any effect can be noticed on the picture. Others can be turned only one revolution in all.

Horizontal linearity. This control makes sure that the voltage applied to the horizontal-deflection coil is smooth and even. If it is jerky, the picture will appear pulled in or pushed in on one side or the other. Like all secondary controls, adjustment is to be made slowly and carefully.

Vertical linearity. Similar in appearance and action to the horizontal-linearity control, the vertical-linearity control is used primarily to correct distortion in the top half of the picture. It acts on the vertical-sweep circuit and its frequency of 60 cycles.

Height. Distortion of the lower half of the picture is corrected by the height control. It is almost always necessary to adjust the height and vertical-linearity controls together. Should it be necessary to adjust either one, only do so to fill the screen. Do not attempt to center the picture by these controls.

MERIT TRANSFORMER CORPORATION

MANUFACTURER OF SET AND MODEL NUMBER	POWER TRANS.		HOR. OUTPUT		VERT. OUTPUT		VERT. BLE. OSC. BLE.	
	MFG. PART NO.	MERIT PART NO.	MFG. PART NO.	MERIT PART NO.	MFG. PART NO.	MERIT PART NO.	MFG. PART NO.	MERIT PART NO.
ECA—(Continued)								
(Ch. KCS24B-1-C-1, ERK1A, ERK4,	72177	P-3063			72952	A-3035	71775	A-4000
KCS20A1-B-1, KCS21A-1)								
8T241-2-4, 8TV321-B,	73567	P-3063	73570	HVO-3	73568	A-3035	73569	A-40001
8TV323-8, 9T240-8,	73601	P-29524						
9TC240, 9TV333(Ch. KCS28-A-B-C-30-1)								
8T270, 9T270-1,	74143	P-3061	74145	HVO-5	73568	A-3035	74144	A-40001
8TK320, 9T270,								
9TC272-5(Chassis KCS29A-C, KCS33A-1)								
8TV329, 9TV329(Chassis 32-A-B-C)	74046	P-3063	73570	HVO-3	73568	A-3035	73569	A-40001
9T37, 9T77-9, 9T89(Chassis KCS49-A-	75508	P-3058	75585	HVO-8			74144	A-40001
AT-T, KCS60-A-AT-T)								
630TCS, 630TS, 6TS30	71415	P-3061	71416	HVO-3	71417	A-3035	71418	A-4000
(Chassis KCS-20A-1, 20B-1, 20J-1)								
721TCS, 730TV1, 730TV2	71772	P-3058	71416	HVO-3	71774	A-3035	71775	A-4000
(Chassis KCS27-1-2)	71975	P-29514						
RADIO CRAFTSMEN RC109			19X006	HVO-6	199007	A-3037	195601	A-30001
RC100A			19X010	HVO-6	195009	A-3036	195601	A-30001
RC200								

You will need to become familiar with parts catalogues like this one

Horizontal drive. This control regulates the amplitude of the pulse fed to the horizontal-amplifier tube and thus affects the high voltage to some extent. Any adjustment of this control will also have an effect on the horizontal linearity, width and occasionally the horizontal hold, so that these adjustments may have to be "touched up" after changing the horizontal drive.

Horizontal and vertical centering. These controls vary the current flowing through the deflection coils. They are not found on all receivers. Those which do not have such controls center the picture by the positioning of the focus coil around the neck of the picture tube. This is adjusted by means of a shaft which protrudes through the perforated back cover of the receiver.

In receivers which have a rotary vertical-centering control, this is remedied simply by rotating the control until the picture is centered. (At no time should the picture or test pattern be centered either horizontally or vertically by using the height, width or linearity controls.)

TV-Circuit Tubes

Although many different tubes are

used in the various makes of receivers, there are some which are commonly used in all types. It will be helpful in servicing your own set to have an idea of the tubes most commonly found in the various circuits. A survey has shown the following chief types:

Tuner—6J6, 6CB6, 6AG5, 6AK5, 6BC5, 6AB4

Sound i.f.—6BA6, 6AU6, 6SK7

Audio amplifier—6AU6, 6V6, 6K6, 6L6, 6SJ7, 688GT

Audio detector—6AL5

Video i.f.—6AU6, 6AG5, 6CB6, 6BA6

Video detector—6AL5

Video amplifiers—6AU6, 6AC7, 6SH7, 12AU7, 6AQ5, 6V6

Vertical sweep—6SN7, 12BH7, 12SN7, 6SL7, 6V6, 12SL7

Horizontal sweep—Same as vertical sweep, above

Synchronizing circuits—12AU7, 6SL7, 6SN7, 6AL5

Low-voltage power supply—5Y3, 5U4G, 5V4, 6X5

High-voltage power supply—1B3, 1X2, 2V3, 6BG6, 6BQ6, 6CD6

Danger Points

Now that the functions of the receiver have been explained and the common tubes listed, a study of those points which contain shock or mechanical danger can be made.

There is only one source of mechanical danger in a television receiver—

the picture tube. The inside of the tube is maintained at a high vacuum. If it should break, air would rush in to cause an "implosion," and glass would fly all over the immediate area. For this reason you are advised to wear leather gloves and safety goggles when handling the picture tube.

There are real electrical hazards present in a television set. If the proper precautions are observed, however, there is no danger at all. The ones who get hurt are those who are careless or who didn't know the set was "loaded."

After a receiver has been turned on, a charge is built up in the many condensers which lingers long after the power is turned off. To prevent shocks during repair, this voltage should be discharged, or "bled." The metal chassis offers good discharge points.

In discharging the high-voltage lead to the second anode of the picture tube, grasp the lead firmly by the rubber cap that surrounds the contact point and break the connection. Discharge, or "bleed off," the electrical energy remaining by touching the metal tip of the lead to some portion of the chassis. Frequently there will be an arc at the point of contact. This is caused by the stored energy jumping over the gap to the grounding point. When this arcing stops, the charge is fully dissipated and the contact of the lead is safe to touch.

The picture tube itself, if of the glass envelope type, has a coating on the outer surface. Called the "dag," this coating often holds a charge which, though slight, should be discharged. If it is not you might get enough of a jolt to drop the tube. Any piece of insulated wire will serve as a medium for

discharging this and the other storage points in the set.

How to Make a Shorting Tool

For the amateur repairman, an 18-inch length of ordinary lamp cord can be made into a satisfactory shorting, or discharging, device. Bare both ends of the wire and twist together the two conductors at each end. A half inch of bared wire is sufficient. If a soldering iron is available, it is wise to solder the bared ends to prevent fraying of the strands and to give the ends stiffness. Next, take two short pieces of wood, about 4 inches long, and tape them at each end of the rubber-covered section, leaving the bare wire protrude. This will provide a handle at each end.

To use this shorting tool, touch one end to the part that is to be discharged and the other end to the chassis. This provides a free path for the electricity to flow out. Sparking will result when this is done, but this is harmless and need not cause you concern.

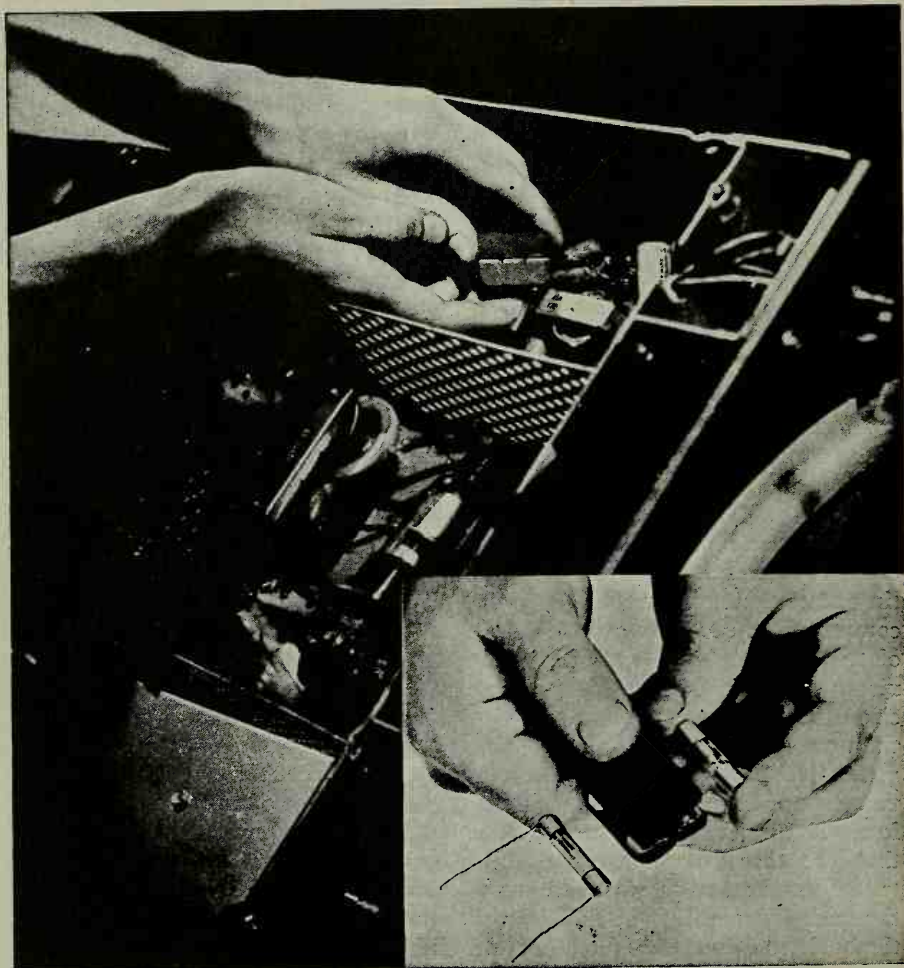
Remember to keep your fingers well back of the bare ends of the shorting wires and do not permit any part of your body to touch the receiver. Amateurs are not likely to be careless when performing this operation the first few times. But the point to remember is that care must always be exercised even after you have become so adept at the shorting-out process that little thought is given to it. *Do not let familiarity breed contempt.*

How to "Bleed" a Set

The danger points commonly found and the procedure to be followed in discharging them are as follow:

1. High-voltage lead from power supply to picture tube. Remove and short the metal tip against the chassis. An arc will result. Be careful to grasp the lead by the rubber cap and do not let your free hand touch any part of the receiver. Follow the electrician's adage: "Keep your free hand in your hip pocket."
2. Short the cap connections to the high-voltage rectifiers and amplifier tubes to the chassis. This requires removing the cover of the high-voltage supply.
3. Short the outer coating of glass picture tubes to the chassis. Metal tubes are covered by a plastic insulating jacket. Stick an end of the shorting lead under this jacket, make contact with the tube envelope and short to the chassis.
4. If the underside of the chassis is going to be handled, it will be wise to short the positive leads of the filter condensers.

Snap-on fuse holder. Inset photo shows how easily replacement is made



The remainder of this booklet is devoted to common television troubles, their causes and their cures.

Horizontal Bars Across Screen (Loss of Horizontal Synchronization)

Causes — Misadjusted horizontal-hold control, misadjusted horizontal-oscillator transformer, defective horizontal-oscillator transformer, defective horizontal sync-circuit tubes, defective resistors or condensers in the circuits.

Cures—Readjust the horizontal-hold control.

Check tubes by substitution. The tubes which may be involved here are: the horizontal-oscillator tube, horizontal-sync clipper, horizontal-sync separator, horizontal discriminator, horizontal discharge or the AFC tube. Most receivers do not have all these tubes. They are listed here to help the owner identify the ones in his own receiver regardless of how they are labeled. It is not possible to list all the different types of tubes used in all makes of receivers in these circuits, but the most common ones are: 6SN7, 12AU7, 6SL7, 6AL5, 12SN7, 12SL7.

Readjust the horizontal-oscillator transformer. This unit is on the main chassis of the receiver and can be located by reference to the service bulletin and sometimes by referring to the component-layout chart on the inside of the cabinet. This is the device by means of which the horizontal-sweep-circuit frequency is put in step with the pulses from the transmitter. It is generally "slug" tuned. The most common type of horizontal-oscillator transformer is quite easily adjusted. Notice that the threaded shaft which protrudes has a small screwdriver slot at the end. Turn this shaft slowly until the horizontal lines straighten out and

the picture appears clear. This should be done with the horizontal-hold control centered, so that after the adjustment has been made on the transformer there is play on either side of the hold control. This is a primary control, and the play is needed for making small adjustments.

Replacement of resistors or condensers will usually require the services of a technician unless you have had radio-repair experience and own an ohmmeter for testing.

Horizontal Overlapping (Picture Folds Over on Itself from Side)

Causes—Defect either in the horizontal-sweep circuits, damping circuits or possibly the sawtooth generator circuits. Slight change in values of components which may be compensated for by adjusting secondary controls.

Cures—Adjust horizontal-hold control. Adjust width or linearity controls. Make these adjustments very carefully as it is not too likely that they will cure this trouble. If they do not, return the controls to their original positions and go on to the next step.

Replace the damper tube. Commonly used damper tubes are the 5V4, 6W4 and 6AS7. A weak damper tube is the most common cause of horizontal overlapping.

Failure of the above cures to remedy the trouble indicates a serviceman should be called. If equipment is available, check the resistors and condensers in the damping circuit.

If the foldover is quite pronounced — both sides of the picture lapping over the center — check the tubes in the horizontal-sweep circuits. Most likely offenders are the horizontal dis-

charge, horizontal output, horizontal-amplifier tubes. 12AU7, 6BD5, 6BQ6, 6BG6 are commonly used types.

Wrinkled Edge on the Picture

Causes—Defective damping tube, defective deflection yoke or components in the deflection circuits.

Cures—Although it is very seldom that a defective damping tube will cause wrinkles, it is the simplest thing to replace for this defect and should be tried first. Common types are 5V4, 6W4 and 6AS7.

The deflection yoke has a number of small components—resistors and condensers—mounted on it. Some of these may be at fault in this case and should be replaced.

The deflection yoke itself will sometimes cause wrinkles. Because there is small likelihood of these yokes going bad, it is not worth while to keep one on hand to check the old one by the substitution method. If an ohmmeter or other test instruments are readily available, resistances and voltages can be checked. The man handy with a soldering iron can replace the small components attached to the deflection yoke at small cost. For component values, refer to the service bulletin.

In doing repair work of the above-mentioned type, the amateur repairman can be quite successful if he is careful to replace components with others of the exact value required, if he labels his wires so that they can be reconnected to the proper terminals and if he makes sure that all solder joints are firm and properly made. All power should be turned off and condensers and other danger spots discharged, of course, before proceeding with work of this sort.

Vertical Line on Screen

Causes—Failure in the horizontal-sweep circuits. (NOTE—This trouble occurs only on receivers whose horizontal-sweep circuits and high-voltage circuits operate independently of each other.)

Cures—Check tubes in the horizontal-sweep circuits. Most likely offenders are the horizontal-oscillator and the horizontal-output or amplifier tubes (12AU7, 6SN7, 12SN7, 6BD5, 6BG6, 6BQ6). In 7-inch receivers, it will almost always be found that this difficulty is caused by a defective 12-SN7 tube.

Occasionally a receiver has a small fuse on the order of $\frac{1}{4}$ -ampere in this circuit. If that opens, the result will be a vertical line. If the horizontal-deflection coil in the deflection yoke opens, there will be no horizontal control applied to the electron scanning beam. If an ohmmeter is available, this can be checked.

Narrow Picture; Cannot Be Widened To Fill Screen

Causes—Defect in the horizontal-sweep circuits or in the low-voltage power supply.

Cures—Although the apparently logical first step is to check the tubes in the horizontal circuits, this is one defect which does not quite conform to the logical way of servicing as the most common cause of a long, narrow picture is weakening of the low-voltage power-supply rectifier tube. As a general rule, the narrowing comes about rather gradually. The first step, then is to substitute in the low-voltage power supply. The most common tube in this circuit is a 5U4G. 5V4G tubes are

occasionally used, as well as 5Y3 tubes. In the latter case, two or more are often found instead of one single tube as the 5Y3 is not capable of performing as much work as either of the other two types. As this power supply also affects the other tubes in the set which receive and amplify the signals, it will usually be noticed that the overall performance is improved in replacing a defective one.

If, after trying the low voltage rectifier tube, the picture still is too narrow and cannot be widened with the width control, substitute the horizontal-oscillator and amplifier tubes. The horizontal-output or amplifier tube is, incidentally, the most expensive one in the receiver excepting the picture tube. In replacing any of the tubes in the horizontal-sweep circuits, it should be borne in mind that it is almost always necessary to make a readjustment of the horizontal secondary controls—width, speed, frequency, hold and the like. These adjustments should not be made, of course, until the trouble has been cured. Generally speaking, the horizontal-oscillator transformer is that which will require the adjustment so that it can bring the horizontal-sweep frequency in step properly by taking into consideration the changed characteristics of a new tube.

Failure of certain other components will also cause a long, narrow picture. A shorted horizontal-deflection coil, shorted output transformer, and defective condensers and resistors are possible causes.

Scalloped Edges on Picture

Causes—Defective filtering in the sweep circuits.

Cures—This is a rather difficult trouble to cure without proper equip-

ment. It usually occurs in the vertical circuit and indicates that a ripple from the 60-cycle components is getting through due to failure or leakage of a filter or by-pass condenser in the sweep circuits. Unless one has testing equipment available, it is necessary to call a serviceman. If equipment is handy, check the by-passes in the centering circuits and the filtering condensers in both sweep circuits. The same effect can be brought about by defective filter condensers in the power supply.

Picture Split by Vertical Black Line With Portion of Picture On Each Side of Bar

Causes—Defective horizontal discriminator or sweep circuits.

Cures—Adjust discriminator or oscillator transformers in horizontal-sweep circuits. As previously mentioned, these transformers are usually the slug-tuned type with a threaded screw for control.

Defective discriminator tube (6AL5).

Analysis of this trouble will logically lead to the conclusion that the horizontal-sweep frequency is twice what it should be so that two pictures instead of one appear.

Picture Rolls Vertically (Loss of Vertical Sync)

Causes—Poorly adjusted vertical-hold control, defective tubes in vertical-sweep circuits, defective small components in vertical circuits.

Cures—Adjust vertical-hold control. This is best done by rotating the control until the picture moves downward very slowly. Then reverse the rotation to the point where the picture snaps back into a steady position.

Replace tubes in the vertical-sweep section. These include the vertical-synchronization tubes, both clippers and separators. Types used are 12AX7, 12AU7, 6SN7, 12SN7 and 6J5 tubes.

Failure to correct this defect either by adjustment of the hold control or substitution of tubes in these circuits is evidence of the failure of a small component. This is best repaired by a serviceman. As always, any replacement of small components should be attempted only by those with some knowledge of radio repair.

Horizontal Line in Center of Screen (No Vertical Sweep)

Cause—Vertical-sweep circuits have developed failure.

Cures—Replace vertical-oscillator or amplifier tubes. The common ones used are 6AQ5, 6SN7, 12BH7, 12SL7, 12SN7, 6V6, 7C5.

Check the vertical-linearity and height controls by moving them slightly while observing the picture. These are usually carbon potentiometers, and over a period of time arcing can occur which will burn a small spot at the point of contact and break the circuit. If this does happen, it is sometimes possible to clean the offending component by pouring into it some carbon tetrachloride, which washes out the grit. At other times, slightly moving the control contact off the bad spot will bring back the vertical sweep with a slight sacrifice to height or linearity.

The best cure, of course, is to replace the control that has gone bad. This is very simply done if one has available the direct replacement, pliers and a soldering iron and is careful to install the new unit in exactly the same way as the old one.

If tube replacement does not cure the trouble and the height and vertical-linearity controls are good, any further repairs should be attempted only if one has an ohmmeter for testing. If an ohmmeter is available, continuity should be checked on the vertical-blocking transformer, the vertical-oscillator transformer and the vertical-deflection coils in the deflection yoke. Open resistors and shorted condensers in the vertical-amplifier circuits can be at fault.

Picture Too Large or Too Small Vertically

Causes—Vertical-sweep circuits, vertical-linearity and height controls, voltages to vertical circuits not proper.

Cures—Adjust height and vertical-linearity controls.

Replace vertical oscillator and/or amplifier tubes.

Check small components in this circuit.

Check voltages applied to vertical-oscillator and amplifier tubes to see if they meet the standards set by the manufacturer in his service bulletin. If not, the supply voltage should be traced back to the source to see where the trouble lies.

Top and Bottom of Picture Out of Proportion

Causes—Linearity and height controls misadjusted, defective vertical-amplifier tube, defective components in the vertical-oscillator and vertical-amplifier circuits.

Cures—Readjust the vertical-linearity and height controls.

Replace the vertical-amplifier tube—6SN7, 6AQ5, 6J5, 12AT7.

Check small components with an ohmmeter.

Picture Jumps Vertically Up or Down

Causes—Vertical-hold control set too critically, vertical-sync circuits not operating properly, poor filtering, interference entering through antenna.

Cures—Reset vertical-hold control. Picture should snap in position with a good, positive action. If not, trouble lies elsewhere.

Replace vertical-sync-circuit tubes—sync clipper, sync separator, etc. Checking the filtering usually incurs a fair amount of signal tracing to find where alternating current may be entering the circuit and is usually a job for the professional serviceman.

If the trouble is caused by interference which enters through the antenna system, as would be the case where ignition noises and other electrical interference is the cause, only two real cures are available—reorienting the antenna for minimum interference and replacing the lead-in with a coaxial or shielded type. Of course, it is possible to trace down the source of interference and shield it, but that is often quite difficult to do and even after the cause is found it may not be possible to cure it.

Occasionally, microphonic tubes will cause the picture to be jumpy. Tap the tubes in the vertical circuits lightly while watching the picture on the screen. If it jumps when any one tube is tapped, this is the likely trouble-maker.

Vertical Overlap

Causes—Defective vertical-deflection yoke, defective vertical-oscillator, vertical-amplifier or output tubes. Misadjusted height or vertical linearity.

Cures—Substitute—one by one—for the tubes mentioned above.

Check the adjustment of the vertical-linearity and height controls. In many cases, trouble of this sort is caused by an attempt on the part of juvenile members of the family to “fix the television set.”

Deflection yokes have several small components—resistors and condensers—mounted inside the cardboard casing. If the foregoing cures are ineffective, it is advisable to remove the yoke and check these components with an ohmmeter. It may not be possible for the amateur to identify which is the horizontal and which the vertical section by tracing the leads. To find out quickly, disconnect the yoke and measure the coil resistances, which are given in the service bulletin. If the resistance measurements of the wire that compose the coils match those given in the bulletin, the coil itself is all right. To check the small components themselves, one end of each should be disconnected, otherwise the readings may be inexact.

Picture is Split Or Two Complete Pictures Appear Vertically

Causes—Improperly set vertical-hold control, or a defective component in circuit.

Cures — Readjust the vertical-hold control.

Look for a defective tube in the vertical-sweep and sync circuits by substitution. It is unlikely that any of these will cause the difficulty, but it is possible and should be attempted as it's one of the easier things to do. Possible defective components are: vertical-oscillator transformer, resistors and condensers in the oscillator and amplifier circuits.

No Picture, No Sound Picture Tube Not Lighted

Causes—Receiver not plugged into electrical outlet, power cord defective, safety-interlock switch not properly connected, fuse in receiver blown, power-transformer primary open, defective on-off switch, defective low-voltage-rectifier tube, open tube filament in a.c.-d.c. sets, short in set, etc. There are other causes possible for this trouble. Some can be very obscure.

Cures—Remove the receiver plug from the electrical outlet and test the outlet by plugging in a lamp to make sure none of the house fuses has gone bad.

Check the power cord for an obvious break. If an ohmmeter is available, check continuity by connecting it to the prongs on the power-cord plug. The line should read open—infinite resistance—with the power switch in the “off” position. In the “on” position, there should be a reading of some sort. Lack of a reading with the power switch turned to the “on” position indicates an open power cord, poor contacts or a defective safety-interlock switch, a defective “on-off” switch, an open primary in the power transformer or, possibly, some other open circuit among the most common of which would be the fuse. All possible troubles which can be checked without completely removing the chassis from the cabinet should be investigated. The interlock, the power cord and usually the fuse can be checked merely by removing the back of the set. Replace defective wire or switches.

CAUTION should be exercised if the fuse is found to be defective. Often a fuse will open because of age, a small surge in the power supply or for some

other very temporary reason. However, it must be borne in mind that a fuse is a protective device and that the usual reason for its failure is that some circuit in the receiver has developed a short, thus drawing excessive current. If the fuse does not open but permits this condition to go on, it is quite possible that the continued operation of the receiver will cause one or more components to burn out, wires to burn and a great deal of damage to follow. Therefore, whenever a fuse has gone bad, do *not* short it out by wrapping tinfoil around it or jumping the contacts with a piece of wire. Replace it with a fuse of the same value. This is a simple matter. Fuses are most commonly of the “pigtail” type, that is, a small glass tube, metal-capped at each end and with a wire lead soldered to the metal cap. Small “snap-on” devices are available on the market which can be snapped on the fuse in the circuit and another good fuse snapped on the back of the device. The photos on page 11 show how this is done. Whenever a new fuse is needed, it is a simple matter to snap it into the snap-on fuse holder. Further replacements can be made without effort.

A less commonly used method of connecting a fuse into a circuit is by use of the “fuse-extractor post.” This is more expensive for the manufacturer, entailing an additional component besides the labor of installing it. However, some receivers do have such posts, generally at the rear of a chassis. Replacement of a fuse in this case is done by simply unscrewing the cap, removing the fuse and inserting a new one. As always, care should be exercised to replace with the proper-sized fuse.

"Slo-Blow" fuses are often found. A "Slo-Blow" fuse is one which will not open immediately with a slight current surge or build-up such as occurs in filter condensers, but opens only after the rating has been exceeded for a short period of time. Thus the nuisance of changing fuses constantly because of small surges is alleviated and the temptation to insert fuses of higher value to reduce the number of blowouts is removed.

The procedure to follow in replacement of a defective fuse is simple but should be adhered to rigidly. Insert the fuse of the proper value. Turn on the receiver and watch very closely for any sign of arcing, smoke, smell of burning, odd streaks on the screen of the tube or other indications of trouble. If these do occur, turn the power off immediately. The indications given show that the fuse went out in its capacity as a safety device and not because of some trouble within itself.

Perhaps the most common cause of a dead receiver is failure of the low-voltage rectifier tube. If inspection shows the filaments of the tubes to be lighted but there is no sound, picture or raster, the first culprit to suspect is the low-voltage rectifier. This supplies B-plus voltage in almost all receivers except a very few with a special power supply. Check this tube then by inserting a known good one. Rectifiers are 5U4G, 5V4G, 6X5, 5Y3, 7X6, 25Z5, etc. Note that the letter following the first digit in rectifier tubes is usually one from the last part of the alphabet. Remember that some receivers use more than one low-voltage rectifier tube, in particular those with 5Y3 tubes.

In some types of a.c.-d.c. television receivers, where the tube filaments are

in series, failure of the filament of one tube will cause the whole receiver to become inoperative just as failure of one light in the old-fashioned Christmas-tree series circuits would cause a whole string to go out. If the pins on the tube base to which the filament leads are connected are known, each tube can be tested for this defect with an ohmmeter. Otherwise, find the difficulty by substitution or by removing the tubes from the receiver and having them tested.

Replacement of a defective on-off switch, a defective power transformer, an open circuit in the receiver or similar troubles is too difficult for the average person to undertake unless he is positive where the trouble is. Open transformers and defective switches are best found by checking continuity. They should be replaced with a manufacturer's replacement or by a standard type. In some cases, a transformer which is proper for the job cannot be mounted without drilling new mounting holes in the chassis. If tools are available, this is not difficult to do and often quite feasible in that it enables a "stronger" unit to be used in replacement than was originally installed. Generally speaking, work of this type should be left to the serviceman.

No Picture, No Sound Picture Tube Lighted

Causes—Reasoning will show that in this case the high voltage is operating, the receiver is getting power and the trouble must lie in some section which carries or in some way controls both the audio and picture signals. The fault could be in the antenna or its lead-in, the tuner, or, in receivers using the intercarrier system, the intermediate-frequency amplifier circuits.

Cures—Check the antenna system for a break in any of the connections either at the antenna itself or along the lead-in or at the point at which it is connected to the receiver. If a folded-dipole antenna is used, the lead-in and antenna can be checked by connecting an ohmmeter across the conductors at the receiver end without going on the roof. If continuity shows, the trouble lies elsewhere. Indoor antennas are highly suspect as they are handled so much that leads are more often broken.

Check the tubes in the tuner by substitution. The most likely offender is the oscillator tube. Tubes used in tuners are 6J6, 6AG5, 6AK5, 6BC5 and 6BC6. It is possible in some types of tuners that the switch mechanism has become defective and no contact is being made when the knob is turned. This is rare, however. Repairs on tuners are quite critical, particularly if they involve realignment and circuit-component replacement, so that most servicemen prefer not to tackle the job but will usually recommend a new replacement.

Check the tubes in the intermediate-frequency amplifiers. This applies to the intercarrier-type receivers where the sound and picture signals follow along the same path to the detector tube. Common tubes are 6AU6, 6BA6, 6AC7 and 6CB6.

Open resistors, open coils, open or shorted condensers and the like can cause this trouble. Simple tube failure or a break in the antenna lead is the cause in almost all cases, however.

Sound But No Picture (Tube Does Not Light)

Causes—The failure must lie in a circuit which lights the picture tubes

or controls the electron beam or video output. Therefore, the possibilities are the picture tube itself, the high-voltage power supply, the horizontal-sweep circuits and the vertical-sweep circuits or the video-output circuits.

Cures—Check the picture tube and make sure the filament is lighted. This is seen by looking inside the neck of the tube after removing the back cover. If the filaments are not lighted, either the transformer which supplies the voltage has become defective, a socket or connector between that source of power and the picture tube has lost contact or the tube itself is bad. If a voltmeter is available, the output of the kinescope filament transformer can be checked. If the transformer is defective, replacement should be made in the usual manner. Sockets and connectors are easily checked to make sure they are not loose or that a lead is not broken. In some picture tubes, it has been found that the filament wires are not properly connected to the pins on the tube base. If this is the case, the tube is defective and should be repaired or replaced by the dealer, distributor or manufacturer under the terms of the warranty. If the sockets, connectors, transformers, etc., are good, and the filaments do not light, the inference to be made is that the picture tube is defective and should be replaced.

If the high-voltage power supply is defective, there will be no light on the picture tube. Perhaps this is the most common failure in television receivers and in the majority of cases it is due to a simple tube failure. The presence of sound indicates that the low-voltage power supply is functioning properly. Therefore, only those tubes directly affecting the high voltage need be test-

ed. As most receivers use the flyback or kickback high-voltage system, the failure of the horizontal-oscillator tube which provides the triggering impulses will cause the high voltage to go out. Check by substitution. The common tubes are 6SN7, 6SL7, 6AL5, 12SN7, 12BH7, 12AU7. Next, substitute the horizontal output or amplifier tubes—6BG6, 6BQ6, 6CD6—and the high-voltage rectifier tubes—1X2, 1B3, 2X2, 2V3. Occasionally, high-voltage power supplies are independent of the other portions of the receiver in which case all tubes in the supply are potential offenders.

CAUTION! In making substitutions in the high-voltage supply, be sure the power cord is disconnected and all discharge precautions are carefully observed. Replacement of other components in the high-voltage power supply are made in the usual manner.

Check the tubes in the video-output circuit.

Check the ion trap. There are times when a receiver is jarred so badly that the ion trap becomes misadjusted. This is a rather complicated adjustment which most people will find best performed by a serviceman.

Adjust the brightness and contrast controls. If these are defective they can cause the trouble cited. However, such a cause is most uncommon. More common, oddly enough, is the fact that some people fail to turn up their brightness controls and call a serviceman to repair a nonexistent defect. Defective small components, controls and the like cannot be found with certainty without test instruments. If instruments are available, the standard continuity and voltage checks will isolate the trouble so that repairs can be made.

~~~~~ Sound But No Picture, Tube Lights

Causes—The trouble must lie in a circuit which affects only the video signal. This could be the video i.f. circuits, the video detector or the video output. One further cause is possible. Occasionally, a "screwdriver" mechanic will attempt to better his picture by adjusting i.f. transformers or some tuner components. If the picture is lost because of this there is no recourse but to call the serviceman and let him take the receiver to his shop for a complete realignment.

Cures — Replace the tubes in the video i.f. circuits. These are 6AU6, 6CB6, 6BA6, 6AQ5, 6AC7, 6AL5, 6AG5.

Replace the video-detector tube—6AL5, 12AU7.

Replace video-output tubes — 12AU7, 12SN7, 25L6, 6AC7, 6AL6, 6V6.

Open coils, resistors, etc., are found by using test instruments.

~~~~~ Picture But No Sound

Causes—Defect must lie in those circuits which carry only the audio signal. These are the audio i.f., audio detector or discriminator, audio amplifiers and speaker.

Cures—Check the speaker cable and plug to make sure that contact has not become broken. This sometimes happens during a housecleaning period when a mop or broom is pushed under a console television receiver.

Check the audio-output tubes first—6V6, 6K6, 6F6, 6L6, 25L6, 7C5—then the audio-amplifier tubes, which can be the same types plus 6SQ7, 6SJ7, 12SQ7, 12AT6, and then the detector or discriminator tube. Audio-detector tubes are many and varied, but the

6AL5 is the most popular in the TV sound system.

If the defect is not uncovered at this point, the next step is to try the audio i.f. tubes. Receivers using the intercarrier method of sound detection and amplification will as a rule have only one i.f. tube in the audio system—a 6AU6, 6BA6, 6SK7, 6SJ7, etc. Those in which the sound and video signals follow separate paths have more.

If the replacement of tubes has no curative effect, the speaker can be checked. This is a most unusual difficulty and shows up generally in a gradual manner. Because of the necessity of matching impedances and the fact that some receivers use permanent magnets whereas others are the dynamic type, it is not too practical to check by substituting the speaker from another receiver—radio or TV. The simplest check is to apply an ohmmeter to the voice-coil leads of the speaker. If there is continuity or the speaker diaphragm or cone moves with a slight click as the leads are applied, then the speaker itself is not the cause of the trouble. If an ohmmeter is not available, applying an ordinary 1½-volt flashlight battery to the leads also will cause it to click and move. The leads can be identified easily in most cases. Many sets have only the two leads going directly to the voice coil from the chassis. Others may have several, some of which go to a transformer or a choke mounted on the speaker casing. The voice-coil leads can be identified by observing which are attached to the cone of the speaker itself.

The sound section of a TV receiver is very much like a regular radio receiver. The major difference lies in the fact that certain circuits of a television

receiver—notably the tuner—carry both sound and picture signals. Besides the possible causes listed as trouble sources, defective transformers, coils, condensers, resistors and controls also can result in loss of sound. Trouble shooting in the audio is, therefore, to be carried on as it would be in a radio, always bearing in mind that when the set is turned on there is high voltage in the video circuits which should be avoided with care. Anyone with a knowledge of radio repair should have no difficulty servicing the sound section of a TV receiver. Without that knowledge, the services of a repairman should be used.

Distorted Sound

Causes—Defective tubes, defective components, improper alignment, rubbing voice coil in speaker, torn speaker cone, misaligned detector transformer.

Cures—The same cures as those tried for lack of sound should be tried in this case. Tube replacement is less likely to correct the trouble but should be attempted. Inspect the speaker for a torn cone. If the cone is torn, it frequently can be repaired by patching it with stiff paper similar to construction paper and cementing the patch with airplane glue. This, of course, is possible only if the tear is relatively small. A rubbing voice coil indicates complete replacement or having a professional put in a new cone. Rubbing can be checked by removing the speaker and gently pushing the cone in and out with the finger tips, taking care not to tear or punch the cone. The cone should move freely with no apparent friction.

Alignment of any sort should not be attempted without proper test equip-

ment such as a signal generator, output meter, oscilloscope, etc., as well as a knowledge of just what one is doing.

Shorted or leaky condensers, defective resistors and the like are found with test instruments.

Weak Sound

Causes — Same as in "Distorted Sound." Open condensers, changed value resistors and weak tubes are the most common causes of weak sound.

Cures—Same as for distorted sound. It is also possible that the low voltage being supplied to the audio circuits is deficient. If the picture is excellent but sound is weak and the cause is poor voltage, the circuit must be traced out to locate the seat of the trouble.

Poor alignment can be determined by adjusting the position of the fine-tuning control. If good clear sound can be obtained at any point regardless of the picture quality, then misalignment is indicated. The indicated procedure is to call a serviceman, but in some receivers an adjustment of the oscillator "slug" in the tuner will rectify the trouble. Such cases are rare and are most often found when the oscillator tube has been replaced. To adjust, gain access to the oscillator adjustments on the tuner either through the front panel as provided for in some receivers or by removing the receiver from the chassis. Make all adjustments with an insulated alignment tool, since the metal in an ordinary screwdriver affects the circuit.

Hum. Picture and Sound Good

Causes—Noisy tube, misalignment, sound traps misadjusted.

Cures — Except for checking the tubes, there is little the layman may

do in this case. Misalignment is only to be corrected with proper equipment. Faulty settings of sound traps are, generally speaking, jobs for the serviceman. And, as is usual, the trouble can be caused by a faulty by-pass or filter condenser which will require test instruments to find.

Picture Smeared

Causes—Fault lies generally in the video-i.f. or video-amplifier circuits. It is necessary to amplify all portions of a video signal equally and, in order to do so, circuits composed of certain small components are designed. Any defective part in these integrating and compensating networks can cause smearing. Occasionally, one of the video tubes will become slightly defective and give the same results.

Cures — Check by substitution the video tubes.

Further attempts to correct this trouble should be made only by qualified service people.

Picture Not Centered Horizontally or Vertically

Causes — Centering controls misadjusted, deflection yoke misadjusted, centering controls shorted, ion trap misadjusted.

Cures—Adjust centering controls. If they fail to bring the position to center, but do have an effect on the positioning of the picture, the control itself is not defective but a misadjustment of the deflection yoke is indicated. To adjust the deflection yoke, loosen the holding screws that hold it in the bracket and move it slightly until the picture is centered. Be careful to keep the yoke well forward and pushed against the bell of the picture tube.

If adjustments made with the centering controls fail to move the picture at all, the control itself quite probably is shorted or the associated components in the centering circuit are defective—generally a shorted condenser will be to blame.

Misadjustment of the ion trap occasionally results in improper centering.

Picture Tilted

Cause—Misadjusted deflection yoke.

Cure—Adjust deflection yoke as described under "Picture Not Centered." Be careful to tighten the holding screws after the adjustments are made to prevent the yoke from slipping again should the receiver be jarred.

Picture Out of Focus

Causes—Focus control misadjusted, focus coil misadjusted, focus control or focus coil completely or partially shorted, ion trap misadjusted.

Cures—Readjust focus control. Occasionally, it will seem that the focus control adjustment will almost—but not quite—focus the picture. If that is the case, the focus control should be set at the center point of its rotation. Then, readjust the focus coil, which is located around the neck of the picture tube. To adjust the focus coil, it will generally be necessary to loosen the set screws which hold it in position. Carefully move it back and forth or tilt it as seems necessary to (1) focus the picture all across the screen and, (2) make sure there are no dark shadows on the screen. Some receivers have no variable focus control at the rear of the chassis or on the front panel. This type requires that all focusing be done by the focus coil, either by manipulating it manually with the back off or

by means of a shaft which protrudes through the back cover.

If adjustment of the focus control has no effect, the implication is that the control itself is shorted and should be replaced. Also, resistors shunted across the control may be shorted. A shorted—either partially or complete—focus coil is best determined by using an ohmmeter. In testing the resistance of the coil, disconnect one of the leads so that the resistance of the coil only is being read.

A slight misadjustment of the ion trap will often defocus a picture. Move it in the prescribed manner to determine if this is the cause.

Occasionally, a defective picture tube is indicated by the inability to focus the picture. This is decidedly the exception rather than the rule.

Portion of Picture in Shadow or Cut Off

Cause—Misadjustment of the focus coil or the ion trap.

Cure—Readjust the focus coil and ion trap. Remember that the focus coil is an electronic lens. If it is not focused properly the electron beam will not be swept across the face of the screen in the proper manner but will be emphasized on some spots and not on others. Thus, a shadow or shadows will result. It may be necessary not only to move the focus coil back and forth but also to tilt it up and down or sideways. The ion trap is a likely offender.

Insufficient Brightness

Causes—Ion trap not set properly, picture tube defective, defective brightness control, wrong voltages supplied from power supplies.

Cures—First rotate the brightness control with the contrast turned down

low. If there is no apparent change in brightness the indication is that the brightness control is defective and should be replaced.

Readjust the ion trap. This may be necessary particularly after a set has been jarred or moved.

Replace the high-voltage rectifier tube—1X2, 2X2, 1B3 or 2V2. Replace the horizontal-amplifier or output tube—6BG6, 6BQ6, 6CD6. Replace the horizontal-oscillator tube—6SN7, 6SL7, 6AL5, 12AU7, 12SN7, etc. These tubes are all part of the high-voltage supply. Obviously, a picture not bright enough can mean that insufficient high voltage is being provided, and a weak tube in the high-voltage power supply can bring about that result. Replacement of the horizontal-oscillator tube often means a readjustment of the horizontal-oscillator transformer will be necessary.

If the rectifier tube—5U4, 5V4, 5Y3, 25Z6, etc.—is weak, it is possible to have good sound and still not have a bright picture as this tube supplies voltage to the horizontal oscillator. It likewise should be checked.

Replacement of the high-voltage, or flyback, transformer is sometimes necessary. Because this transformer is generally in a shielded compartment and space is at a premium, it is wise to make sure the replacement used is a direct one.

Because of the expense involved, the picture tube is usually the last item to be checked. Unless the picture has been growing dimmer gradually, there is not too much reason to suspect the picture tube itself as being the seat of trouble. The only satisfactory check to be made for a defective picture tube is direct substitution, and a picture tube is a rather expensive item to keep on

hand or to purchase should the kinescope be suspected. Having picture tubes on hand for substitution checks is an advantage the professional serviceman has over the amateur.

Weak Picture, Poor Contrast

Causes—Antenna system partially shorted or connections broken, weak r.f. tube, defective video i.f. or video-amplifier tubes, defective video-detector tube, misalignment of the i.f. or video-amplifier circuits, poor signal from station.

Cures—Make certain the trouble applies to all stations by tuning each one in. If all but one are good, the inference is that the poor station has had its signal affected temporarily.

Replace the r.f. tube—6J6, 6AK5, 6AG5, 6BC5, 6BC6.

Replace video i.f. tubes—6AU6, 6BA6, 6CB6.

Replace video-amplifier tubes—6SJ7, 12AU7, 6AG5, 6V6, 6SN7.

Replace video-detector tube—6AL5, 12AU7, 6SN7, 12SN7.

Check the antenna system from the antenna down to the connections at the receiver. Often, antennas which are mounted on chimneys gather a tremendous amount of soot and oil waste which is very detrimental to efficiency. This should be cleaned off.

If none of the above cures is effective, the most likely reason for a weak signal or picture is a misalignment of the circuits carrying the picture signal. Realignment of these circuits is a job to be performed only by a qualified technician. Also, the weak picture may be brought about by changed values of components whose locations are best determined by the technician with testing equipment that will enable him to find the weak spot.

Uneven Shading

Causes—Most common one is man-made, that is, a misadjustment of the contrast control. A d.c. restorer tube or circuit may be defective.

Cures—Adjust the contrast control when a test pattern is available to make sure the shading of the concentric rings is even and regularly graduated.

If contrast-control adjustments are ineffective, replace the d.c. restorer tube—6AL5, 12AU7—or check the last video-amplifier tube.

Picture Appears Snowy

Causes — Receiver location in a fringe area where signal is weak, antenna system not sensitive enough or not properly connected, weak amplifier tubes, particularly r.f. amplifier tube in tuner, poor alignment.

Cures—Check the antenna system. First make sure that all the leads are properly connected and that the lead-in is held in position away from gutters, etc., by stand-off insulators. Check the orientation of the antenna to make sure it is aimed at the point from which the greatest signal strength comes. Also, if the receiver is in the fringe area, be sure that the antenna used is the one which has the maximum pickup for the frequencies on which the desired stations are operating. An efficient antenna is a must in the fringe area, but even one coupled with a booster will not entirely rid the picture of snow.

Check the amplifying tubes. Just as there are various degrees of strength among healthy people, so will tubes of the same types vary in amplifying ability although all check good. When purchasing a supply of tubes to keep

on hand, it is worth while asking the dealer to test several and choose those which have the highest amplification factor for the video i.f. amplifier circuits. You will probably have to pay for this service—and rightly so—but it's worth it to fringe-area dwellers.

If stronger tubes, good antennas and proper orientation do not correct a snowy picture and receivers of the same make and model in the same locality do have good pictures, take the receiver to a serviceman and have him completely realign it and check it thoroughly for good solid connections.

Poor Detail, Picture Not Clear and Sharp

Causes—Poor alignment, misadjusted fine-tuning control, occasionally, but seldom, defective components.

Cures—First make sure that the cause is not misadjustment of the fine-tuning control by tuning in a station with the test pattern on. If unable to adjust the fine-tuning control so that the lines in the vertical wedges are sharp, clear and not merged until they reach the center of the pattern, then the assumption is poor alignment. This is a job for the serviceman.

Picture "Blooms" and Appears Too Large

Causes—Defective high-voltage power supply, defective picture tube.

Cures—Check the tubes in the high-voltage power supply, particularly the rectifier—1B3, 1X2, 2V3.

Defective small components in the high-voltage power supply. To be checked with instruments.

Defective picture tube. Check by substitution.

*Picture Very Dark and Dull
Brightness Control Operates O.K.*

Causes—Defective high-voltage power supply, misadjustment of the ion trap, defect in the d.c. restorer circuit, defective picture tube.

Cures—Adjust the ion trap for best position.

Check the tubes in the high-voltage power supply.

Check the d.c. restorer tube, if any.

Check the picture tube by substitution.

The most common causes of this trouble are a maladjusted ion trap and/or a defective picture tube. As it is unlikely that the ion trap will become misadjusted unless the receiver is jarred, the picture tube itself must be held up as the probable cause.

White Lines Through Picture

Causes—Brightness control turned too high, d.c. restorer circuit defective, low-voltage-to-picture-tube components improper, defective condenser in video-amplifier section, defective video-amplifier tube, vertical deflection critically set.

Cures—This is a difficulty that can be brought about by a multitude of causes and is most annoying. It can be present with a poor picture or a good one. Sound is seldom affected. Unless the simple cures correct the trouble, it is unwise to delve too deeply into the receiver as the offending component may be obscure and difficult to find.

Readjust the brightness control. Too much brightness will make the retrace lines visible. Back it off till the lines are blanked out.

Check the d.c. restorer tube by substitution. If no tube is used in this circuit, then the various components

must be checked with test instruments.

Check the setting of the vertical-hold control. Occasionally, if these controls are set just at the point where the "rolling action" stops, the retrace lines will appear. Rotate the control until the picture is firmly locked in position.

Check the video-amplifier tubes by substitution. There is a possibility that a defective tube in these circuits may be causing the trouble. A leaky condenser in these circuits can also be the cause.

Check the components in the video-amplifier section.

If the picture is weak and the sound not too good, replace the low-voltage rectifier tube — 5U4, 5V4, etc. This should bring up both the sound and picture and erase the lines. If it does not, suspect some other component in the low-voltage power supply.

A defective picture tube can cause this trouble, but it is most unlikely. If the foregoing remedies have failed to correct the trouble, the services of a professional repairman are called for.

Negative Picture

Causes—Defective picture tube, defective video circuits, overloaded power circuit.

Cures—Check the picture tube. This is often an indication of a defective picture tube.

Check the video amplifier and video i.f. tubes—6AU6, 6BA6, 6AG5, 6CB6, 6SJ7, 6SN7.

Check the video-detector tube — 6AL5, 12AU7, 6H6, 6SN7.

Components in any of the video circuits can be suspected in this trouble. Usually, however, the difficulty may lie in a phase-shifting network, crystal diode or some hard-to-find component.

Ghosts on Picture

Causes—Reflections from external surfaces to antenna or mismatched impedances in the transmission-line.

Cures—Check antenna for direction and line interferences.

Top or Bottom of Picture Blacked Out

Causes—Defective low-voltage power supply, horizontal-sync circuits defective, clipper circuits defective. (Usually accompanied by a wavy action of the picture.) Defective vertical-sync circuits.

Cures—Replace tubes in horizontal-sync circuits—6SN7, 6AL5, 12AU7, 12SN7.

Replace tubes in vertical-sync circuits—same as above.

Check sync-separator tubes—12AU7, 12SN7, 6SN7, 6AL5.

Check tubes in vertical-sync circuits, particularly if the picture is blanked out in the top half and the flyback-retrace lines are visible. In almost all cases when part of the picture is blacked out the fault lies in either the sync or clipper circuits and is specifically a defective tube.

Occasionally a defective filter condenser which will allow an alternating current ripple to pass will have the same effect. Therefore, if tubes are not to blame, filter condensers that apply particularly to the sync and video circuits should be suspected.

Picture Fades In and Out

Causes—Virtually all receivers have an automatic gain-control circuit, called AGC, whose purpose is to compensate for slight variations in signal strength and thus maintain an even picture. If the picture fades in and

out, therefore, either this circuit is defective or the variations in signal strength are too great for the AGC to compensate. Causes, therefore, could be a defective AGC tube, a defective component in the AGC circuit, a loose antenna which sways in the wind, air planes that interfere with or reflect the signal, or a defective video-detector tube, which often provides the AGC voltage.

Cures—Check the antenna system. Make sure that the mast is firm and steady. See that guy wires are taut. Inspect the lead-in to make certain that it is not loose and flapping. Check the lead-in for frayed spots and good connections at the antenna.

Substitute the AGC tube, if any—6AU6, 6AG5.

Check the video-detector tube—6H6, 6AL5, 12AU7.

Check for loose connections in the video circuits, particularly at the antenna input, the r.f. amplifiers and the tuner.

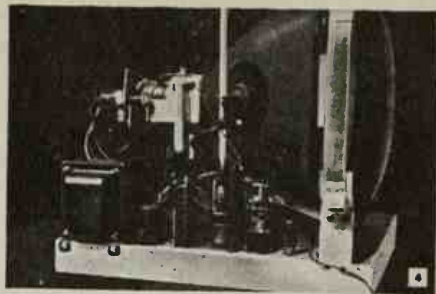
A defective filter condenser in the AGC circuit will cause this trouble also.

Black Bar of Varying Width Across Center of Picture

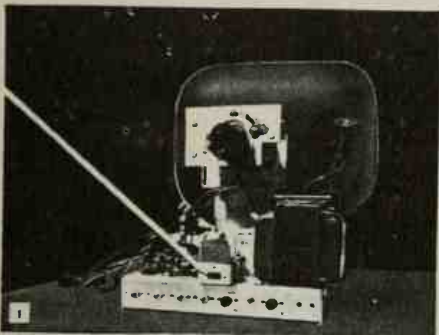
Cause—This indicates the "60-cycle hum" is present in the video circuits. The usual 60-cycle alternating current which supplies power to the receiver is rectified and filtered. This keeps a varying voltage from being applied to the wrong places. Therefore, if it appears on the picture, some filtering component is defective.

Cures—Check the filter condensers in the high and low-voltage power supplies. If the sound is free from hum at the same time that the bar appears on the screen, the indication is that

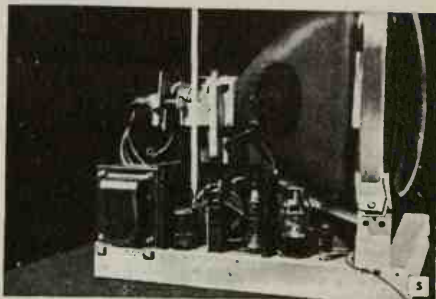
Danger points because of high-voltage buildups in your television set are illustrated on this page. There will be no hazard, however, if you carefully "bleed" the current off these points by shorting them to the metal chassis of the receiver. This picture series also is excellent for familiarizing yourself with your TV set.



High-voltage rectifier tube



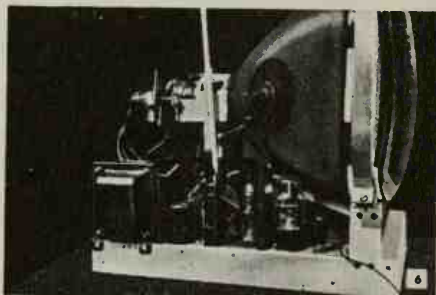
Power-input safety lock



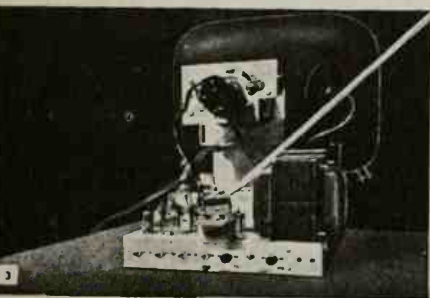
High-voltage amplifier tube



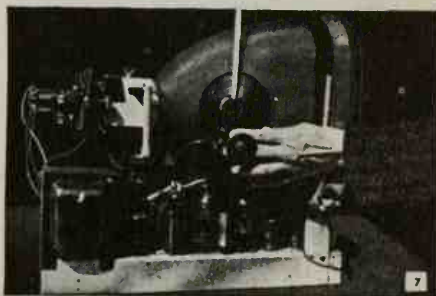
Exposed power fuse



Flyback transformer unit



Snap-on fuse holder



Second anode of picture tube

the low-voltage power supply is functioning properly and the trouble is most likely in the high-voltage power supply.

Check the filter condensers and the high-voltage condensers in the sweep circuits.

Check the filter condensers in the video amplifiers.

Purple or Brown Spots on Screen

Cause—Defective picture tube.

Cure—A new picture tube is the only remedy for this trouble.

*Intermittent Performance
Of Either Sound or Picture*

Causes—An “intermittent,” in the professional repairman’s vocabulary, is a defect which occurs only occasionally—sometimes lasting for a few seconds—and is caused by loose elements in a tube, loose wires, defects in condensers, resistors or coils and the like. This trouble is often very difficult to find.

Cures—To locate a suspected intermittent tube, tap each one lightly with the finger or a rubber mallet. The finger tap, of course, must not be given to any of the high-voltage tubes. Nor is it necessary to hit a tube with a rubber mallet—a pencil end will do just as well.

Tap other suspected components with the end of an insulated screwdriver or some similar light object. Be careful not to use conducting metal when the set is turned on, as it must be when trying to locate an intermittent. Also, be careful not to place a screwdriver shaft or any conducting material across leads in such a manner that they are shorted together. Do not ground any lead to the chassis unless you know what you are doing.

Carefully inspect solder connections. Occasionally a joint is not soldered at all in the manufacturing process. “Rosin” joints are suspect. These are connections where the soldering job has been done improperly so that only a coating of rosin is present instead of a firm joint of solder. These can be determined by turning off the receiver, grasping leads firmly with a pair of long-nosed pliers and gently wiggling them. Care must be exercised so as not to break the lead or the lug to which it is connected.

Another cause of intermittent operation—the defective condenser, resistor, etc.—is more difficult to cure. To find a component that acts properly some of the time and improperly the rest of the time is extremely difficult. Trouble of this sort is the type that makes it necessary for your serviceman to keep your receiver for a long period of time. He cannot cure a trouble that doesn’t show up long enough for him to find it any more than you can. It should be realized that the intermittent trouble is one which may be extremely simple to find or extremely difficult. If vibrations of any sort, such as those brought about by walking across a room, will cause the receiver to act intermittently, it is likely that something in the receiver is loose or a tube has a defect. This type of trouble can usually be located readily. If, however, the trouble is one which comes and goes as the set is or isn’t warmed up, or appears and disappears for no reason at all, the trouble is more obscure and may require treatment in a service shop.

*Receiver Noisy When Jarred
Or Subjected to Vibration*

Causes—Microphonic or noisy tube

in the sound system. Loose connection in cable from chassis and sound output to speaker. Defective tube socket in sound circuits. Worn volume-control contacts.

Cures — Tap tubes to determine which is the offender. It will almost always be one of the sound amplifier tubes.

If tapping the tubes definitely locates the trouble in one spot but replacement of the tube by a known good one does not cure the difficulty, the socket or the connections of the leads to it should be suspected. To check this it will be necessary to remove the receiver from the cabinet and inspect the socket at the underside. Using an ohmmeter to check from the lugs at the bottom of the socket to the points at the top through which the tube pins are inserted will show up a broken socket lug.

Check the cable connecting the speaker to the receiver. The connectors may have worked loose. Occasionally leads are stripped too far or are frayed in such a manner that they rub against the chassis or another lead. Tape the frayed spot or move it away from the point of contact. Rotate and tap the volume control to locate noise at that point.

Noisy Volume Control

Causes—Dirt or worn spots.

Cures—Wash the control by pouring carbon tetrachloride on it from an oil can or with a medicine dropper as it is being rotated. This will wash most of the dirt out.

If washing the control still does not correct the trouble, and particularly if the sound is distorted or dead at one setting of the control, it should be replaced. This is done in the usual

manner by ordering the direct replacement part. In making the replacement, the receiver must be removed from the cabinet. Unscrew the nut which holds the control in place, label the wires or draw a picture showing which color lead goes to the various solder points, disconnect the old volume control and install the new one. This is a simple job, easily performed. The control will cost from \$1.25 to \$1.75, approximately, whereas paying a serviceman to do the work will cost from \$5.00 to \$10.00.

Interference

Causes—Diathermy, automobile ignitions, electrical equipment, other television receivers, amateur radio operators, internal — such as misaligned sound traps.

Cures—Interference cures can best be discussed generally. Interference shows up in various forms—noise in the sound system, horizontal bars from FM interference, loss of vertical synchronization, a curlycued band across the screen caused by diathermy, flashes of light from ignition, flutter by airplanes, moving black dots across the screen, herringbone lines from other television receivers and the like. Internally, if the sound traps are not properly aligned within the receiver, the energy of the sound signal will “leak” through to the picture circuits. This trouble is easily identified, since the interference form will appear in synchronization with the sound as it is spoken or played. The cure for this is a realignment by a serviceman.

If FM interference is suspected, try to tune in the FM station by adjusting the fine tuning control. If the FM station is heard when the volume control is turned up, the simplest cure is to

call a serviceman to adjust the FM trap on the tuner. This trap is usually a combination of condensers and coils at the antenna input to the receiver and can be located by following the antenna lead to the point where it connects with the receiver. Some service bulletins definitely locate the trap and make it easy to find. The interference is eliminated by adjusting the screw shaft on the coil until the FM sound and interference disappear. This is an adjustment that must be carefully made while watching the picture to make sure that its tuning is not disturbed. It will not be possible to locate an FM trap on many tuners; in that case call the serviceman.

Interference from other television receivers is best cured by relocating and reorienting the antenna. It is caused by radiated signals from the oscillator of a nearby receiver, by reradiated signals from a neighboring antenna, radiation from nearby objects and the like. The best cure is to make sure the antenna installed is equipped with a reflector and director to sharpen the directivity of its "aim" and to locate it as high as possible.

Interference from ignitions is best cured by locating the antenna as far away from the street as possible and not running the lead-in in such a way that it will pick up the noise. Should this not be sufficient to cure the trouble, use a shielded lead-in for the antenna. Shielded lead-in consists of the conventional two conductors enclosed in a metal shield. The shield is connected to the chassis of the receiver while the two conductors are connected in the usual way to the antenna terminals. The shield is best connected to the chassis through a .01-mfd. condenser and can also be connected to a

good ground. The final effort to be made in reducing ignition interference is to install a filter specifically made for the purpose. If the interference is caused by electrical equipment, the first step is to clean the unit to minimize arcing. If there is no condenser connected across the brushes on a motor, one should be installed. This again is a .01-mfd. condenser. Installing a filter in the power-line input to the television receiver will often cure the trouble. These are obtained at radio-supply houses, where they are known as "power-line filters."

Filtering of the power line and reorienting or relocating the antenna are the only possible cures for correcting diathermy interference. If neither remedy does the job, the only hope is to be patient and await the day when the offending physician finds it necessary to discard his old diathermy machine and purchase a new one which is properly isolated and shielded to prevent radiation and power noise.

Interference from a radio-amateur's station may be very hard to cure and at the same time can be one of the easiest. It may entail shielding part of the television receiver and it may entail shielding the whole cabinet. The easy part of the cure lies in the fact that radio amateurs as a group are well-informed on the subject of radio and interference and are generally more concerned by the fact that they may be interfering with your TV picture than you are. These amateurs do fine work, perform national services and are to be encouraged rather than castigated. If amateur interference is noticed, therefore, locate an amateur in your neighborhood, call him up and tell him your troubles. In practically all cases he will help you locate the of-

fending transmitter and see that steps are taken to correct the trouble. If the offender is not a radio amateur but one of the many government and commercial transmitters, the "ham" will help identify the frequency of the signal and advise you on the type of filter to install. Treat him well; he can be a good friend to you in your TV problems.

Offending electrical devices in the home can be easily located by noting whether the refrigerator, sewing machine, furnace, or the like causes interference when it goes on. Correct it by making sure each motor has been properly cleaned and that the contacts at the brushes are not arcing. Any motor-repair shop will do the job quickly and cheaply. This has a double advantage as the majority of home electric motors receive too little attention as it is, therefore are dirty and inefficient.

*Arcing in the Receiver
(Identified By an Audible
Cracking or Buzz)*

Causes—Short in a high-voltage lead, loose connection, improper shielding of high-voltage points.

Cures—Watch the high-voltage section of the receiver while it is in operation. If the room is dark, careful inspection—without touching the receiver—should reveal a visible spot which will locate the source of arcing. Turn off the receiver and discharge the condensers in the usual way by shorting out the danger points to the chassis. If the arcing has been caused by a high-voltage lead running too close to the metal chassis or shield cage of the high-voltage supply, move it far enough away to prevent the arcing. If the spark seems to be jumping from the cap of one of the tubes to

another lead or surface, or if it is located at any solder point or contact point, two courses are indicated. The first step is to brush off all dust on the offending source. Then purchase a jar of anticorona fluid at a radio-supply house and coat the surfaces of the joints or tube caps thoroughly and completely with it.

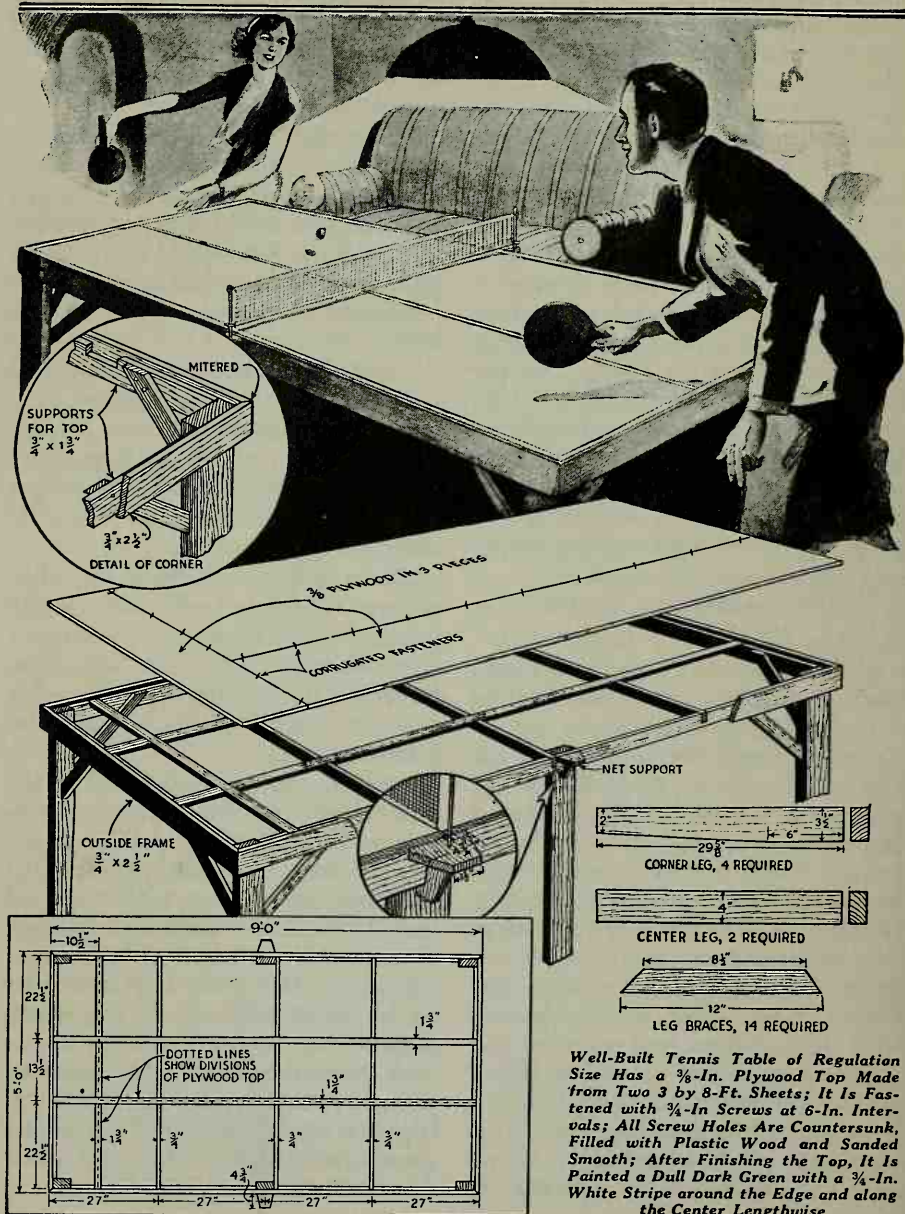
If the high-voltage lead to the picture tube seems to be the offending item, wrap it with a good polyethylene tape and coat it with anticorona fluid. Ordinary friction tape is not an insulator worth mentioning for the radio-frequency, high-voltage arcing of this sort.

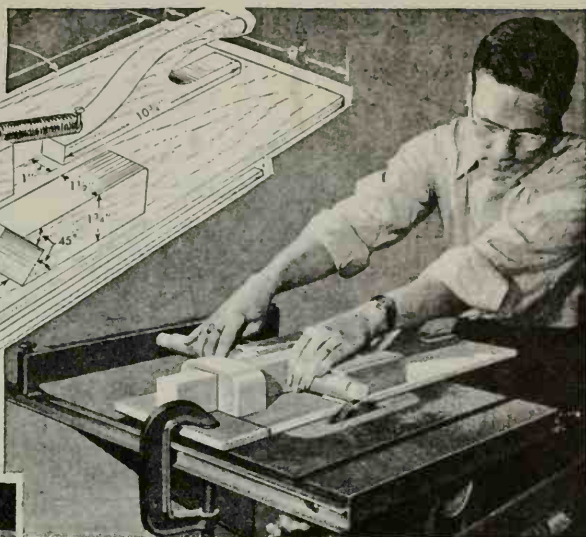
Arcing occasionally will occur at the point where the high-voltage lead snaps onto the picture tube. Inspect this to make sure that it is properly seated and that no dust is present which might provide a path for the current to travel over.

Above all, in searching for high-voltage arcing, be extremely careful not to touch the receiver or push your nose in too far. The high voltage can jump a considerable distance and a nose or finger is as good a place to jump to as any.

Another important warning is necessary before you touch the controls around the neck of the picture tube—the ion trap, the focus coil and the deflection yoke. Any adjustment of these units must be done with the back cover of the receiver off and the power turned on. The chances are that your set or the instruction manual which came with it bears a warning that the back cover should never be removed except by a serviceman. It is this which frightens many people and which does present somewhat of a hazard when due caution is not exercised.

Regulation Size TENNIS TABLE





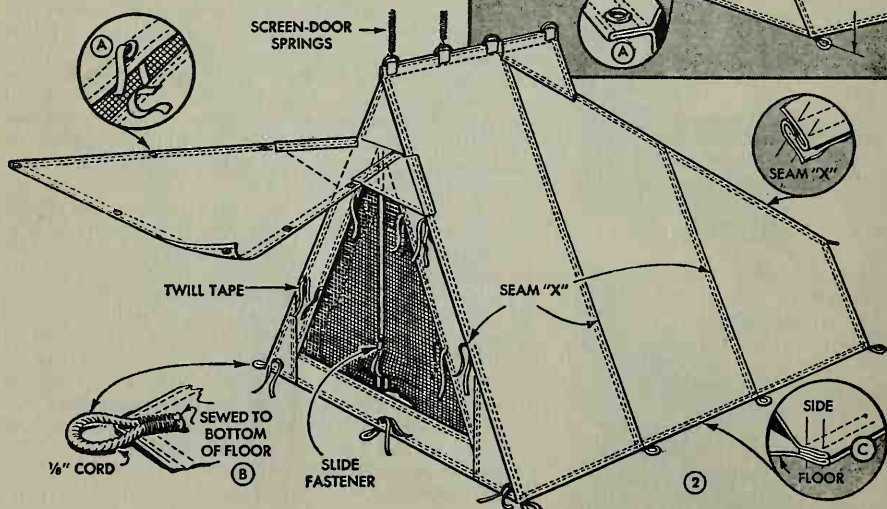
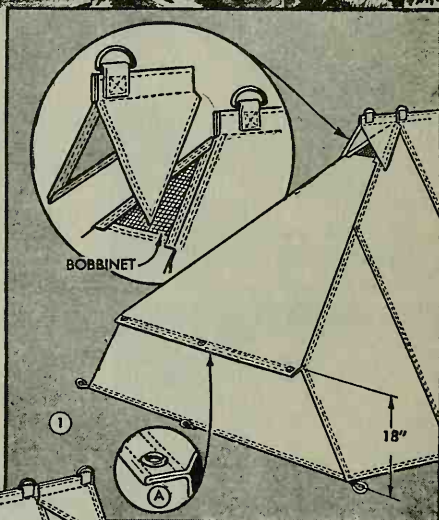
For rounding the ends of dowels a molding-head cutter is used

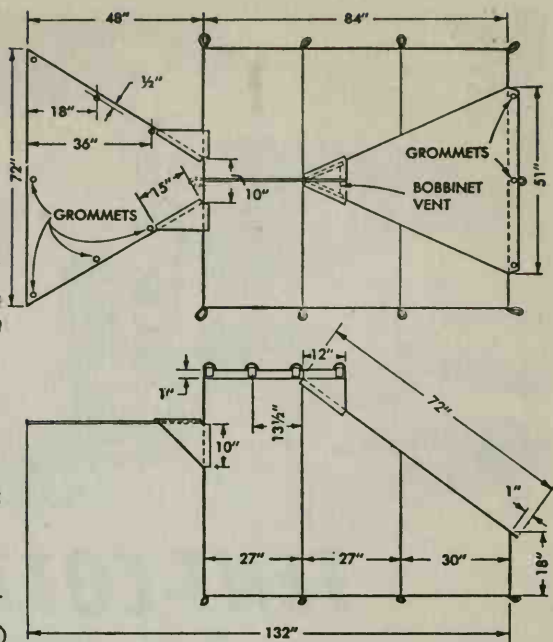
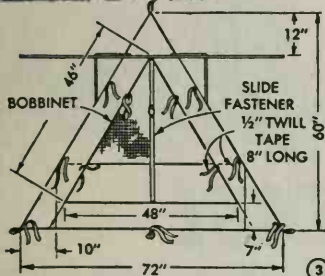
SHAPING a neat, square-shouldered tenon on ordinary flat stock can be done easily with common hand tools and of course it's only a matter of a few one-second passes on the circular saw. But shaping a round or tapered tenon on round stock without a lathe—that is something. Here's a quick, precise way to do it on a power saw. Make up a jig as in Fig. 1, using $\frac{3}{8}$ -in. plywood for the base and hardwood for the fixtures and handle. Fig. 2 shows how this jig works in making a straight tenon. The sliding member of the jig, which is spring-tensioned as shown, acts as a clamp to hold the work firmly against the V-blocks. Simply slide the work into place, locate it over the dado head, raise the latter to the proper height to give the diameter you want and slide the jig against the stop clamped to the saw table. Then turn the work one complete revolution and there you are, letter-perfect. Or maybe you need a number of stakes with one end tapered so that they can be easily driven into the ground. Tilt the saw table, or the arbor, and make the cuts in several passes. You finish up with a neatly tapered end like that shown in Fig. 3. The trick in this is in the depth setting of the head for each pass of the work. With a little care you can get a perfect taper. Then, should you wish to round the other end of the pointed stakes, you can do it quite as easily by using a molding cutter head as in Fig. 4. Select molding cutters of the proper radius and locate the work so that the squared end is over the curved section of the cutter. Turn the work one complete revolution, holding it firmly so that it does not slide to the right or left. Here again a careful depth setting determines the accuracy and neatness of the finished job.

TENT



COMPLETELY insect and vermin proof, this two-man tent is ideal for hikers, canoeists and others who require a lightweight outfit. It is made of waterproofed unbleached muslin and has a sewed-in floor. A bobbinet ventilator, protected by a hooded canopy as shown in Fig. 1, assures ample air circulation under all weather conditions. The door, also covered with bobbinet, closes tightly with a hookless slide fastener. An outside door flap that may be drawn down in case of rain can be tied in place from the inside with the tapes shown in Fig. 2, A. The tent can be set up with inside poles or suspended from a branch of a tree. If the latter method is used, screen-door springs or strips of inner



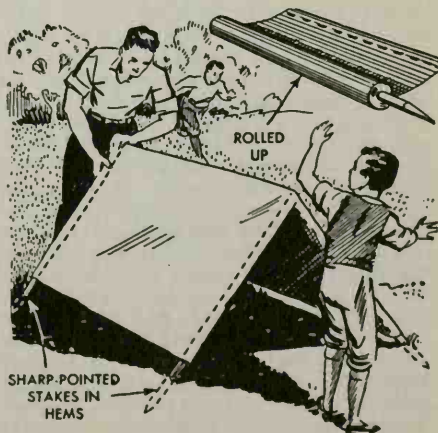


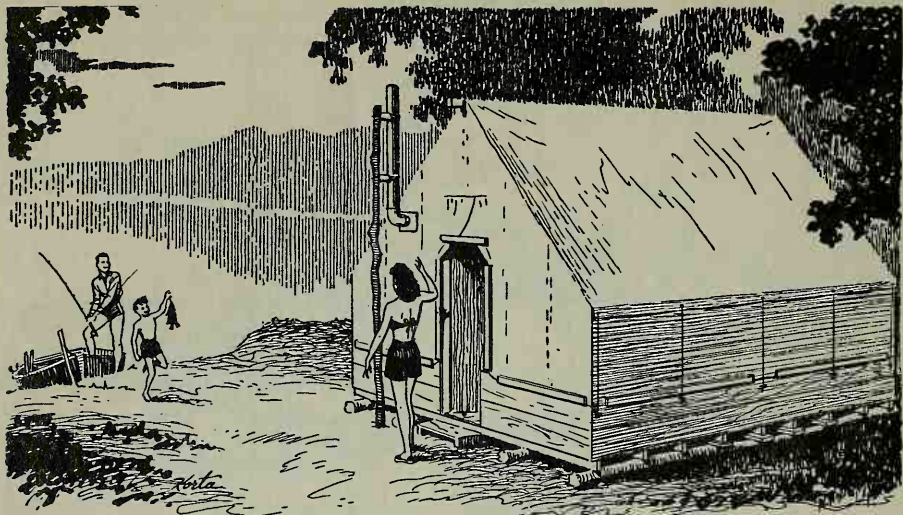
To make the tent, 20 yards of 80 by 80 unbleached muslin will be required. This is laid out and cut according to the dimensions given in Fig. 3. Care should be taken to allow enough material to make the various types of seams shown in the enlarged details of Fig. 1, A, Fig. 2 and Fig. 2, C. Loops of $\frac{1}{4}$ -in. cord then are sewed to the

bottom of the floor as indicated in Fig. 2, B, for the tent stakes. Other materials required are two spools of $\frac{1}{2}$ -in. twill tape, $1\frac{1}{4}$ yards of bobbinet or mosquito netting, one hookless slide fastener 40 in. long, 10 grommets, 20 ft. of $\frac{1}{8}$ -in. rope, four "D" rings, approximately 450 yards of thread and 2 gallons of tent waterproofing solution. A prepared waterproofing purchasable at most sporting goods stores can be used, or a good waterproofing compound can be made by mixing 1 pound of paraffin and 4 oz. of beeswax in a gallon of naphtha.

Pegless Sun Tent Erected Easily In Yard for Children

To avoid any possibility of a small child being injured by falling over pegs used to support a play sun tent, stitch hems in the ends of the cloth to receive four pointed sticks so that the tent may be erected as shown. The absence of both center poles and pegs makes such a tent especially suitable for small children. It is easy to erect or take down, and takes very little space when rolled for storage.

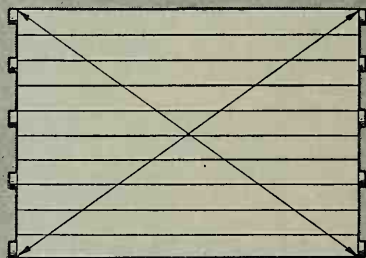




TENT-COTTAGE

DESIGNED at the suggestion of forest rangers by Horace F. Ralph of the U. S. Forest Service, this tent-cottage meets the requirements of hunters, fishermen and vacationists who like to set up comfortable living quarters beyond the trailside at a fraction of the cost of a permanent camp or summer home. It provides a warm, dry room in cold, stormy weather and the braced roof framing and half-height wooden walls give the structure exceptional resistance to high winds.

First, the floor is built on the desired site as in Fig. 1, by nailing floor joists across log sills, or sleepers. Spacing of the joists should be 16 in. on centers and they should be shimmed with blocks or wedges where necessary to bring the top edges flush. Although the specifications call for 1 x 12-in. floor boards to be laid with butted joints, you can use 1 x 6-in. tongue-and-groove flooring if desired. In placing the joists and laying the floor, be sure to dimension the latter 1 in. less in width and length than the floor size of the wall tent you are to use as a covering for the framing, Fig. 2. Figure the height of the corner posts by adding the height of the 1 x 12-in. siding, two boards high (about 23¼ in.) to the height of the tent walls, allowing for a 3-in. overlap so that the fabric wall can be fastened with cleats as in Fig. 3. Cut the corner posts and the center studs to the same length. Toenail the four corner posts and



FLOOR IS SQUARE WHEN
DIAGONALS ARE SAME LENGTH



2" X 4"
JOISTS

WOODEN
SHIMS

LOG
SILL

SIDE VIEW

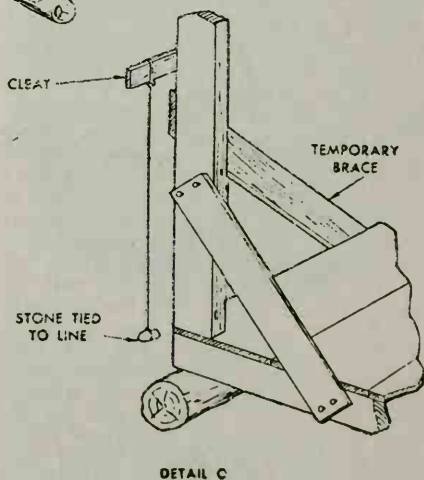
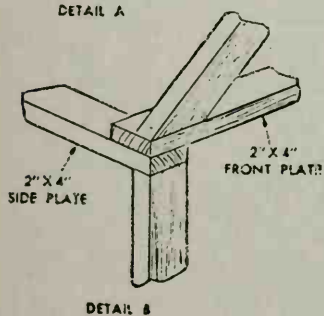
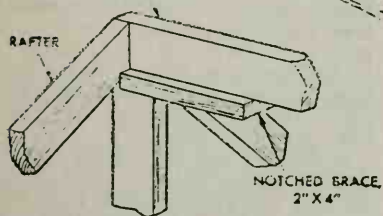
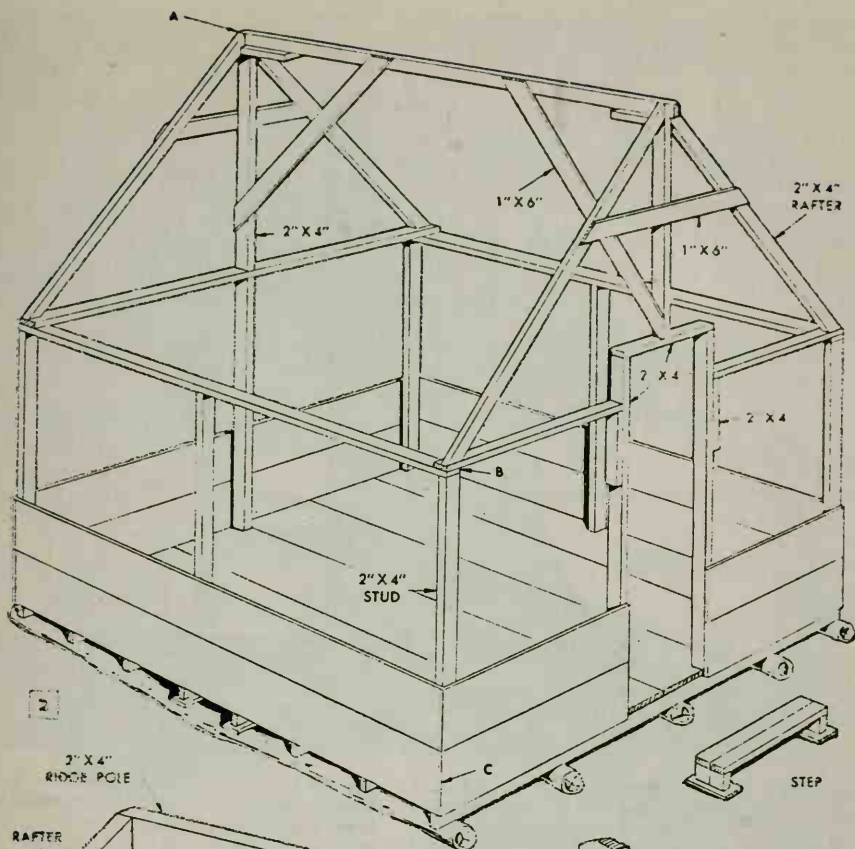


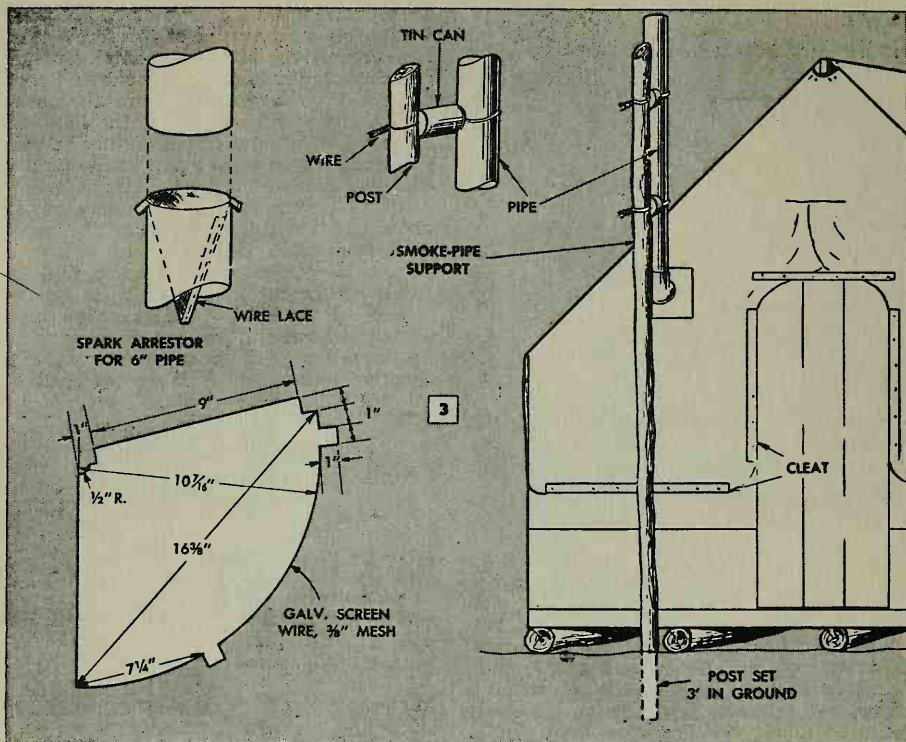
1" X 12"
FLOORING

JOIST

SILL

END VIEW



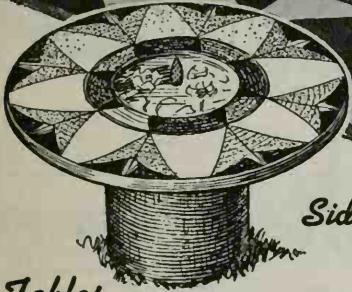
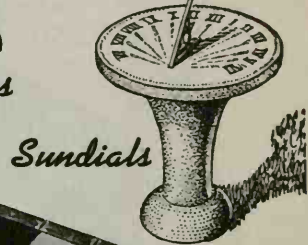
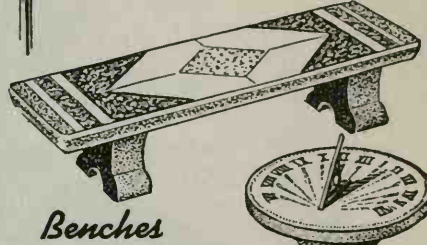


plumb and brace them as in detail C, Fig. 2. If no level is available, use a weighted cord as shown. After plumbing the corner posts, nail the side plates in position first, and then install the middle studs. Now, tie the side frames by nailing the back plate and stud in place. The doorframe is 30 in. wide and 78 in. high, inside measurements. Install the uprights, which serve as jambs, and tie the top ends with a header as shown in Fig. 2. Then nail false studs to the inner faces of the uprights to support the ends of the divided front plate. Toenail the ridgepole supports in place and brace them temporarily. Set the ridge pole in position, toenail it to the supports and then nail the diagonal braces in place. Cut the rafters to fit at the lower ends as in detail B, Fig. 2, and at the upper ends as in detail A. Nail them in place at the upper and lower ends. Now, note the position of the notched braces in detail A. These braces are designed to strengthen the whole roof structure and should be carefully fitted. One end of each brace is notched, or slotted, to fit tightly over the upper end of the ridgepole support and butt against the rafters. In this position it serves as a three-way nailing block, as it is nailed to the bottom edge of the ridge pole, and also to the up-

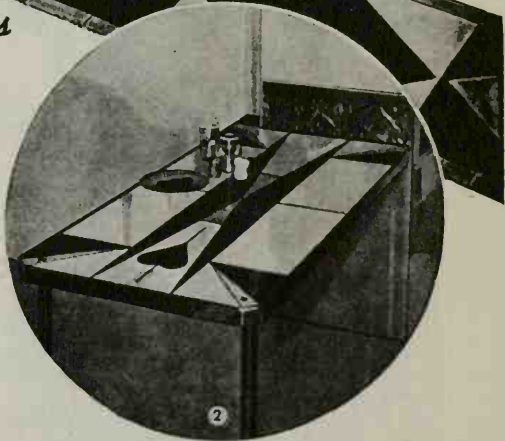
per end of the support from both sides. Finally, nails are driven through the rafters near the lower edges and into the butting ends of the brace. If a tent larger than 10 x 12-ft. floor area is used, install four additional rafters, two on each side. Draw the tent over the framework and fasten the side walls with cleats.

If desired, you can hang a conventional door to swing inward, or make one by cleating boards together to build up to the required width. If the room is to be heated, a smoke pipe is installed and supported by a post as in Fig. 3. The pipe is attached to the post by means of metal spacers made from tin cans in the manner detailed. For your own safety, as well as to prevent forest fires, the pipe must be fitted with a spark arrestor. This is made from galv. screen in the cone shape detailed in Fig. 3, and is installed in the inverted position in the pipe at the first joint below the upper end. Place the stove or heater in a shallow box filled with dry sand. Install a turn damper in the pipe between the stove and the first elbow of the smoke pipe. To protect the tent wall from the hot smoke pipe, install an asbestos flange, or thimble, in an opening cut in the canvas about 8 to 10 in. below the lower edge of the rafter.

TERRAZZO



Sidewalks

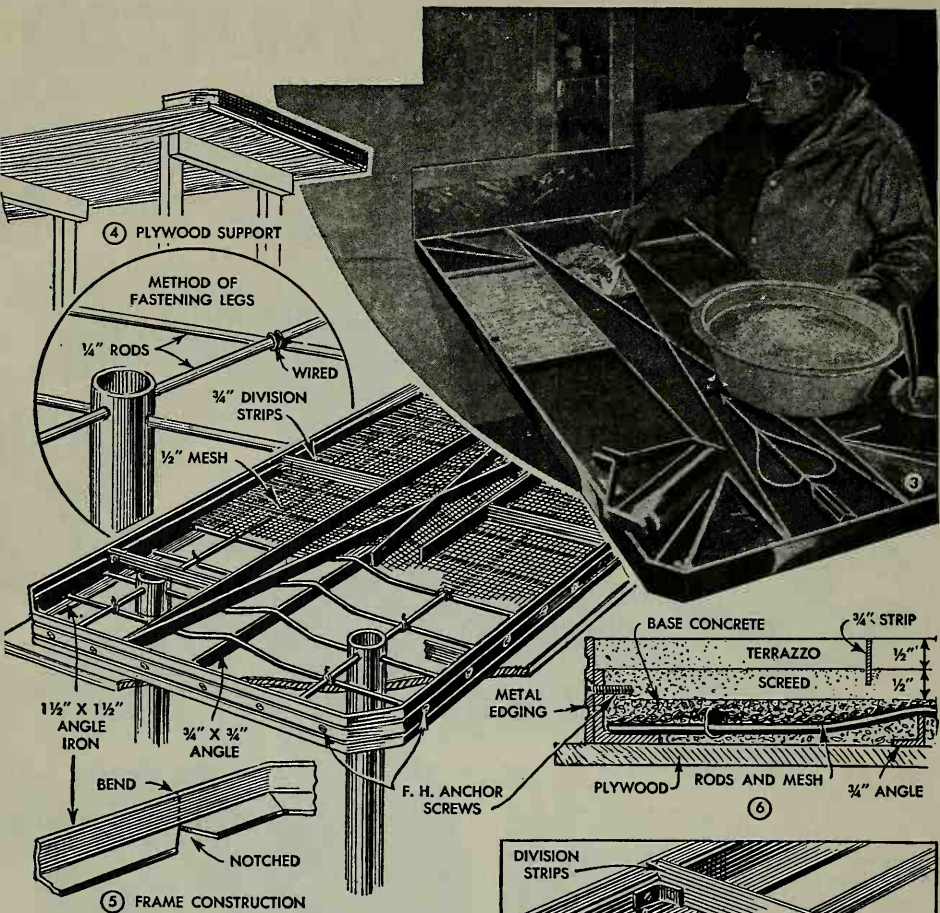


TERRAZZO, a mixture of cement and marble chips, provides a hard surface that is almost everlasting for use as table and counter tops, benches, sundials, sidewalks and many other surfaces subject to hard use or exposure to the weather. Use of cement-coloring materials permits countless color designs to be worked out in the finished surfaces.

Since terrazzo is applied like concrete, it is necessary that a form be used; either a removable one for precasting, or one that becomes part of the completed project. In the latter case the table pictured in Fig. 2 is a good example. Here the form is shaped from angle iron to form a frame as in Fig. 5. A piece of angle iron at the center of the frame supports the reinforcing rods, which are placed crosswise of the frame. Legs can be attached as desired, but one way is to use lengths of metal tubing, which are drilled at the upper end so that the reinforcing rods can be passed through them as in Fig. 5. This method helps provide rigidity, but does not permit removal of the legs. Next, wire mesh is placed over

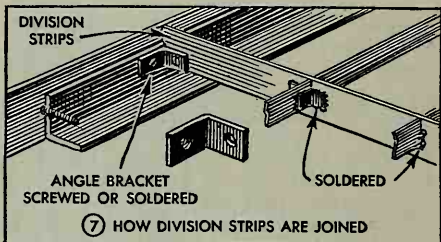
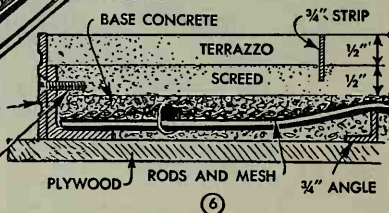
the rods. Following this, a metal edging is screwed to the frame, the latter being drilled and tapped for the screws, which project inside and tend to anchor the terrazzo to the frame.

If a color design is to be used, strips of thin brass or other non-rusting metal are next installed to serve as division strips to keep the colors from mixing when the terrazzo is applied. Usually the strips are soldered together as in Fig. 7 to provide a single unit of the desired shape, which then is set in position and fastened in place

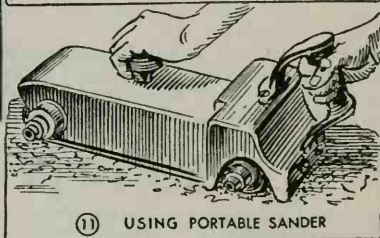
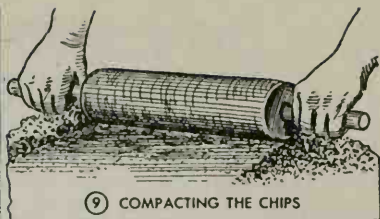
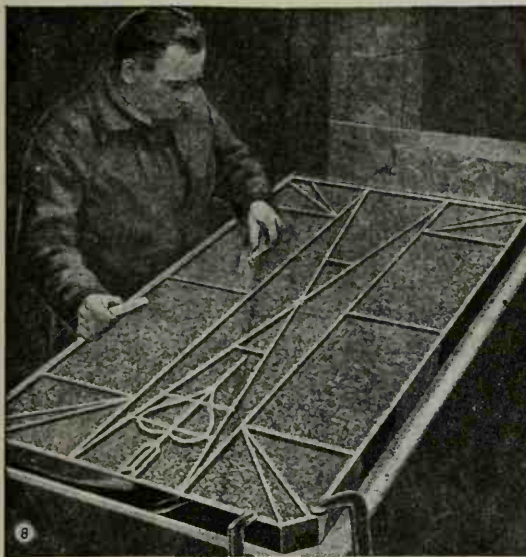


so that the upper edges project slightly above the trim. Figs. 1 and 3 show the division-strip unit in place for this particular table. The frame must be placed on a base while pouring the top. This can be a plywood panel supported on legs or saw-horses as in Fig. 4.

Now you are ready to pour the table top, which consists of a base layer of concrete, then a screed layer and finally the terrazzo, as indicated in Fig. 6. Formulas for mixing the various layers are given in the table under Fig. 8. Mix the ingredients for the base layer dry and then add water to produce a plastic that can be worked into the form. Proportion the thickness of the layers as in Fig. 6. After the base has set for a while, scratch the surface with a piece of wire mesh as in Fig. 8 and leave it overnight, covering it with damp burlap. Then scrape the roughened surface with the edge of a trowel and blow out all loose par-



ticles. A bellows or tire pump is ideal for this. Next, mix and apply a thick coat of grout and follow this immediately with a 1/2-in. layer of screed. If obtainable, add to each gallon of water used in mixing the grout a cup of Antihydro, a product for hastening the setting of concrete. Also, cover the base concrete with this water, let it stand for a few minutes and then soak up the surplus with a sponge. Trowel the screed well in between the division strips and level it. Scratch the screed layer and treat it exactly as you did the base layer. After applying the grout coat on the



FORMULAS

Base concrete: pea gravel, coarse clean sand, and cement, equal parts. Mix dry, then add water to make mix plastic enough to work easily.

Grout mix: pure cement with enough water to bring to consistency of thick cream.

Screed mix: coarse, clean sand, 2 parts; cement, 1 part; water to make thick paste.

Terrazzo: white cement, 1 part; white or colored marble chips, 2 parts by volume; water to make stiff, workable mix.

Red cement: oxide of iron, 1 part; white cement, 10 parts by volume. Mix dry, then moisten.

Separating compound: stearic-acid crystals and clean lard, equal parts. Mix together over medium fire. Apply hot with brush.

screed, you are ready to place one color of the terrazzo. White terrazzo is placed first; then each stronger color in succession. Black is always placed last. Start at the tight corners first. The idea is to have the marble chips packed evenly and as tightly as possible against each other. Let the terrazzo mount $\frac{1}{8}$ in. higher than the division strips. When all white portions of the design have been filled, trowel the terrazzo and let it set for a while. Then roll it as in Fig. 9 to squeeze out the surface cement, which is removed with a moist paintbrush. This process packs the marble chips evenly one against another. Let the terrazzo set an hour or so and then trowel repeatedly to a hard finish. When the terrazzo sets enough to feel hard to the touch, cover it carefully with clean waxed paper, then cover with damp burlap and let cure overnight. Burlap will stain terrazzo so be sure all surfaces are first covered with the waxed paper.

The following morning soak all the work in Anti-hydro water after first having removed the waxed paper. Now mix the next color and proceed as before, following this procedure for each color to be applied. After the last color has been placed, cover the whole surface with waxed paper and moist burlap and let cure for six days. At the end of this time the terrazzo surface is ground down and polished.

There are two methods of grinding: the wet and the dry method. A flexible shaft grinder with a silicon-carbide rim wheel and a wet spindle head will do fast and fine work. Follow coarse wheels with progressively finer grades. Let the wheel move over the surface with an easy motion. Avoid grinding rings or holes in the surface. Follow this with a hand stone, Fig. 10; an ordinary carpenter's silicon-carbide stone is fine for this work.

A portable sander used as in Fig. 11 does good work as a dry grinder. However, one may grind entirely by hand, using a coarse silicon-carbide brick fitted with a handle and a finer oil stone for the polishing. While grinding, use clean water and a sponge to clean the surface so that you can observe your progress. Grind down the surface until it is free of scratches, then polish the metal parts in the pattern with

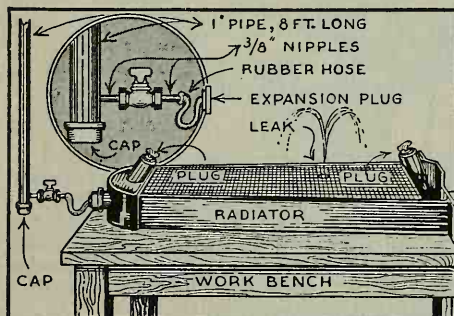
a fine hand stone. Follow this with a thorough cleansing with water.

Some air holes may have been left in the terrazzo through improper placing and rolling of the aggregates. These can be filled with a grout mix of the proper color. Cover the repaired parts with waxed paper and let cure overnight. Then grind again with a fine stone, grinding only enough to remove the surplus grout. Clean with several applications of water; sponge and let dry for 24 hrs. There are numerous preparations for waterproofing terrazzo and making it stainless. A readily available preparation is boiled linseed oil and turpentine mixed in equal parts. Apply to the dry terrazzo surface and wipe off all surplus. Repeat each day for three days as above. Let the final coat dry for 24 hrs. Follow with auto or furniture wax and bring to a polish.

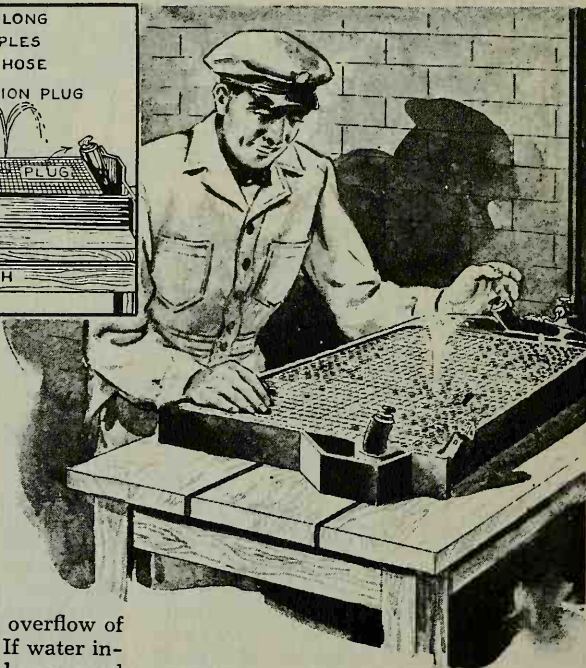
When terrazzo is used outdoors where metal division strips and edging would not be satisfactory, or when the expenditure for metal is undesirable, the terrazzo can

be precast into blocks of the colors and shapes required and then assembled on a base. The terrazzo is cast in wooden forms of the size and shape desired and of uniform depth. The forms first must be varnished and coated with a separating compound to prevent the terrazzo from sticking to them, the compound being made as described in the formula table. Pouring and curing of the terrazzo in the forms is handled in the same way as was done for the table. When completed, the forms are removed and the surface and edges of the terrazzo blocks are ground and placed on a base consisting of concrete and screed built up as for the table, using reinforcing rods and wire mesh in a wooden form, which also must be varnished and coated with the separating compound. Before placing the terrazzo blocks, a grout coat is applied to the base and also between the joints after the blocks have been placed. Grinding and polishing of the terrazzo surface, after curing, completes the job.

TESTING LEAKING RADIATOR



Instead of lifting a heavy radiator in and out of water when testing it for leaks with air pressure, a mechanic saves this work by using a column of water in a 1-in. pipe to produce the pressure. This enables him to place a radiator on a bench, locate the leak and solder it without moving the radiator. The inlet, outlet and overflow of the radiator must be plugged. If water interferes while soldering, it can be removed by taking out one of the plugs. Use of an expansion plug for the filler hole will permit quick attachment to various radiators. Water in an 8-ft. length of 1-in. pipe set



vertically will produce a pressure of about $3\frac{1}{2}$ lbs., which is enough to locate most leaks. It is necessary to refill the pipe after each test to maintain the pressure.

What You Can Do With TEXTILE COLORS



Photos courtesy American Crayon Co.

WITH the new textile colors now available for stenciling on cloth, you can decorate with designs of your own making such articles of home furnishing as tablecloths, towels, napkins, pillows, and drapes as well as dresses, scarfs and other items of clothing. Or, if you prefer, you may select a readymade stencil from the many now available in sizes and patterns to suit varying tastes and requirements. The colors, which are fast, can be applied to any kind of fabric—even oilcloth.

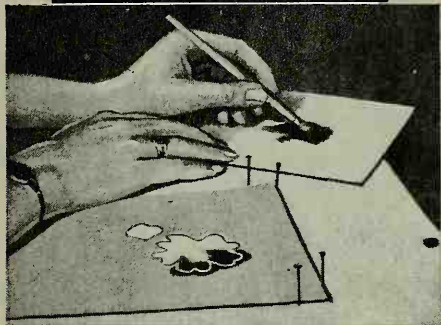
One advantage of this method of decorating cloth is that the same design may be reproduced on all your pieces, or combined with other figures to form combinations or patterns. Then, too, you can use the same figure in several places in different colors, thereby varying the effect with the same stencil. And, best of all, you can produce

in quantity for gifts and yet have sets of finished articles for your own use.

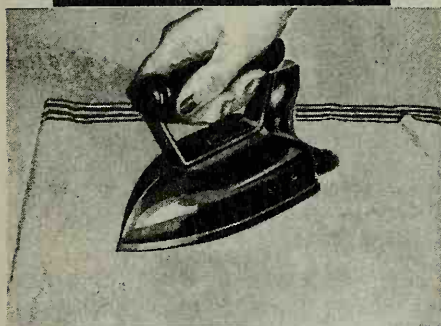
As examples of figure-combinations, one of the photos shows the effect of combining several different figures on a tablecloth. The same design, reduced in size, can be repeated on the napkins if you wish, or a single figure may be centered on the napkins and towels. For pillows, all-over designs are attractive, or merely flowered borders used. Large flower patterns are effective on drapes, dresses and scarfs. Men's furnishings, too, can be individualized by monograms or simple figures applied to the pockets of shirts or to the cor-



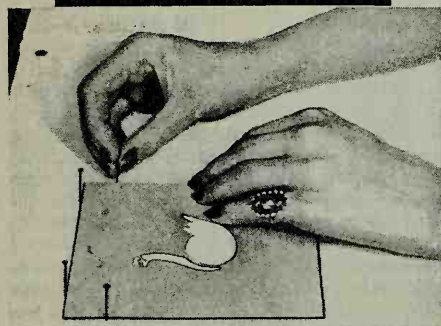
WASH THE CLOTH THOROUGHLY



APPLY COLOR THROUGH STENCIL



"SET" THE COLOR WITH HOT IRON



GUIDE PINS TO ALIGN STENCILS

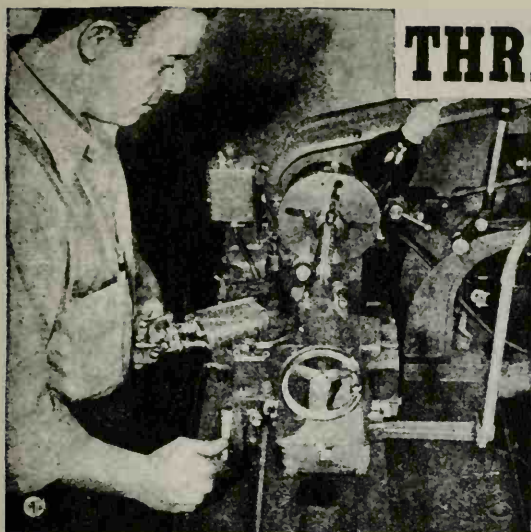
ner of a tie or handkerchief. Umbrellas, bags and sweaters may be similarly decorated.

Textile colors are easy to use—there are just four steps to take in producing a finished piece of work. First wash the cloth thoroughly in order to remove the starch and sizing with which most new materials are filled. Warm, soapy water is best for this purpose. Then rinse well to remove all traces of soap, and press to dry the cloth. Stretch the cloth tightly on a drawing board or other suitable backing such as heavy cardboard that will not buckle or allow the fabric to wrinkle, and fasten the cloth with tape or thumbtacks. Put the stencil over the area you wish to color and fasten it in place with pins or thumbtacks so that it cannot move out of place. Also, be sure that the edges of the stencil are pressed tightly to the cloth, otherwise the color will seep under them and blur the outline. Apply the color with the brush which comes with the kit, using light, sweeping strokes. It is better to apply several light coats than it is to put on a single thick one. Work the color into the fabric, occasionally stippling with the end of the brush to obtain a uniform penetration. Then remove the stencil carefully, taking care not to let any part of it come in contact with the wet color to streak it. Allow the work to dry thoroughly for at least 12 hrs., although leaving it for 24 hrs. is better. Now you are ready to "set" the color. Place a damp cloth over the back of the design and iron it for at least a full minute with the iron heat at 350 degrees. For rayons, use a moderately hot iron at about 200 to 230 degrees. By dampening the pressing cloth with white vinegar instead of water you will increase the "fastness" of the color.

If the design you use calls for a combination of several colors applied to the same area with the use of several stencils, be sure to align each stencil properly so that the colors will be placed in the correct relation to each other. To do this, lay the main stencil—the one containing the major portion of the design—over the spot to be colored and set four guide pins to hold it and the other stencils (all same size) in position.

To make your own stencils, draw on a piece of stencil paper the pattern you wish to reproduce, or copy the design directly by means of carbon paper, and cut around the lines with a stencil knife. The stencil paper and knife may be purchased at an artists' supply house or large department store. Wall paper or magazines often supply patterns that can be used, although, of course, you can originate patterns of your own.

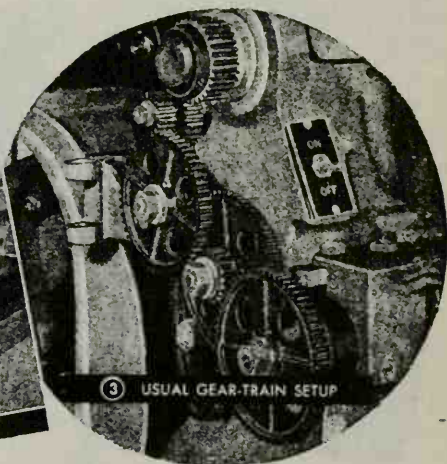
THREAD CUTTING



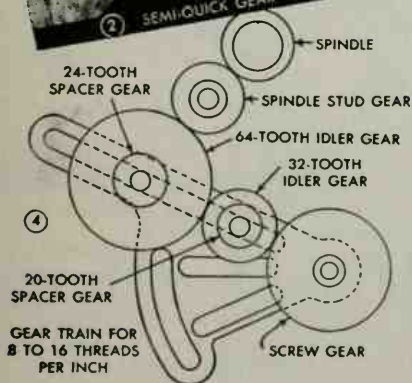
ONE of the most interesting of all lathe operations is cutting screw threads because it requires an accurate sense of timing on the part of the operator and his fullest attention to many details, and also because the work can be varied to cut threads of many different kinds. In ordinary turning, such as in facing, the spindle speed remains constant while the tool can be hand-fed across the work at almost any rate of speed, depending upon the metal being turned. Moreover, the tool can be fed in and stopped at any point on the work without damaging it, except



② SEMI-QUICK GEAR TRAIN TO SPEED SETUP



③ USUAL GEAR-TRAIN SETUP

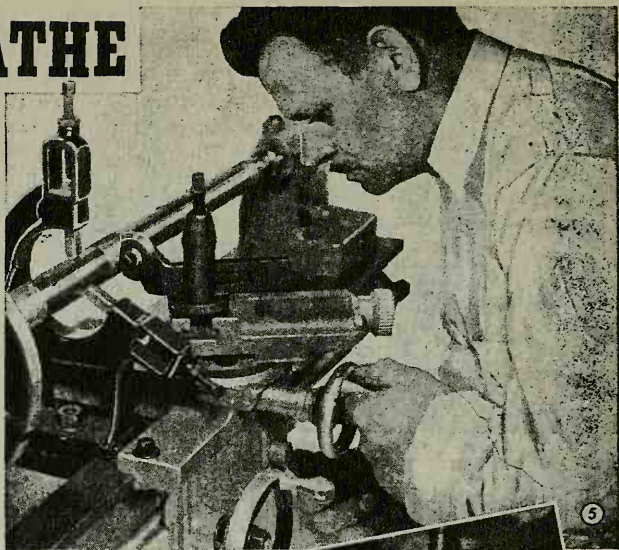


in taking a finishing cut, when a shallow shoulder will result. But in cutting threads, the ratio between spindle speed and rate of feed is of the greatest importance as it determines the pitch of the thread being cut, and the feed cannot be stopped short of the end of the thread unless the tool is withdrawn or it will cut into and spoil the threads. Also, threads generally are not cut in one operation but by successive passes of the tool over the work, the cutter taking a deeper bite at each pass. When the tool has been withdrawn and positioned for the next pass, it can be fed in only at specified intervals so that it will coincide with the thread cut in its previous travel over the work.

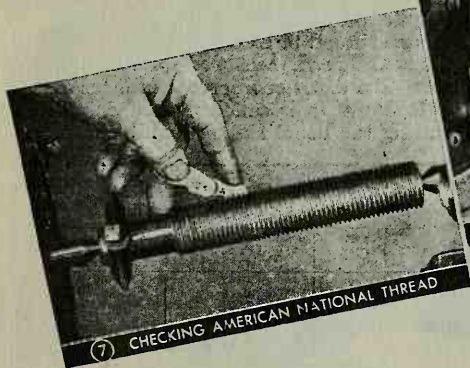
When preparing to cut threads, the lathe,

on your LATHE

and especially the lead screw, must be clean and free from dust and chips. The centers should be aligned carefully so that the work will run concentrically, and the work must be straight and true within .001 in. to assure uniform depth of thread. These precautions having been taken, the next step is to set up the proper gear train to cut the desired thread. This is done by removing certain gears and replacing them with others of different size, or by changing their location, Fig. 3. On some lathes gear changing is done automatically by setting a lever at design-



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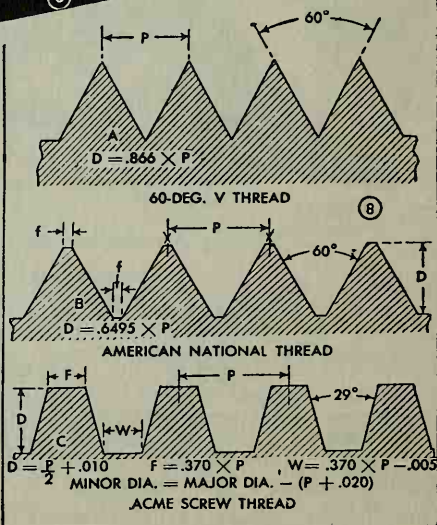


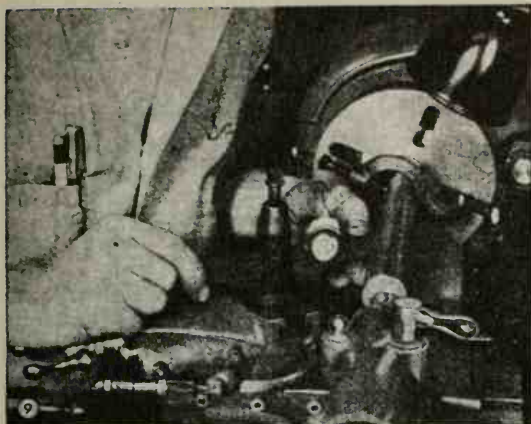
7 CHECKING AMERICAN NATIONAL THREAD



6 CUTTING ACME-FORM SCREW THREAD

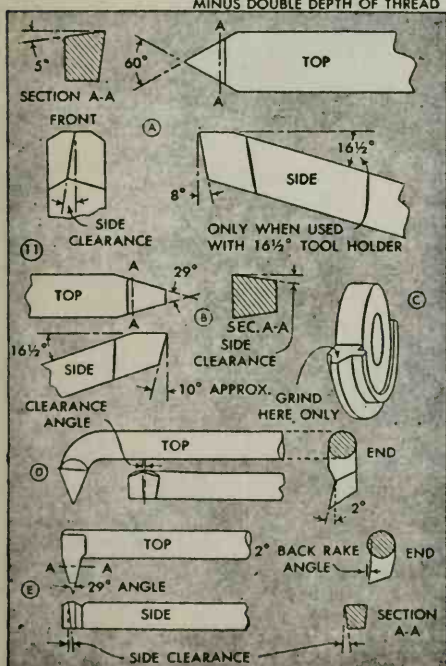
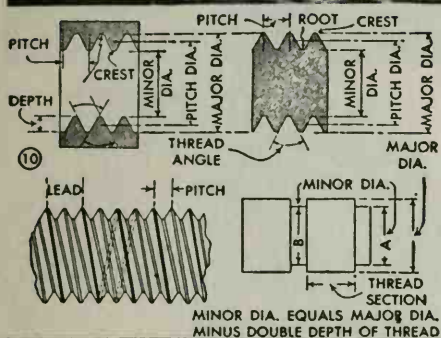
nated positions; others use a semi-quick arrangement of gears to speed the setup, Fig. 2. With the semi-quick setup, six different threads can be cut with the same gear train, whereas with the usual gear train only three different threads can be cut. Regardless of design, all lathes are provided with a chart by which the desired gear train may be selected. It is important, of course, to check the setup to make sure that gears with the proper number of teeth have been selected and that they are positioned in correct order on the bracket, Fig. 4. The gears must be arranged so that the carriage will travel toward the headstock for a right-hand thread. For a left-hand thread, the carriage can be reversed to





travel toward the tailstock. The gears should not mesh tightly but have clearance, as indicated in the detail below Fig. 1. Clearance can be determined by adjusting the gears with a piece of paper between the teeth. When the gears are properly arranged, a small amount of graphite grease should be applied to the teeth for smooth, noiseless operation.

Although there are many forms of threads, only the three most commonly used need be considered here. These are the V, American National and Acme, shown in Fig. 8. Notice that the first two are 60-deg. threads. The V-form generally is used only for fine threading, while the Acme is a coarse, strong thread such as that used on the screw of a lathe. The threads are diagrammed according to a simplified formula in which *D* represents single depth of thread, *P* is pitch, and *F* designates the width of the flat at bottom and top, which are also known as the root and crest. Since the top and bottom of Acme threads are not equal, *W* is used for the bottom dimension. As shown in the upper details of Fig. 10, pitch is the distance from a point on one thread to a corresponding point on the next thread, measured parallel with the axis. The distance a screw advances axially in one turn is called the "lead." When cutting the usual single thread, therefore,



(12) DOUBLE DEPTH OF THE V AND NATIONAL-FORM THREADS

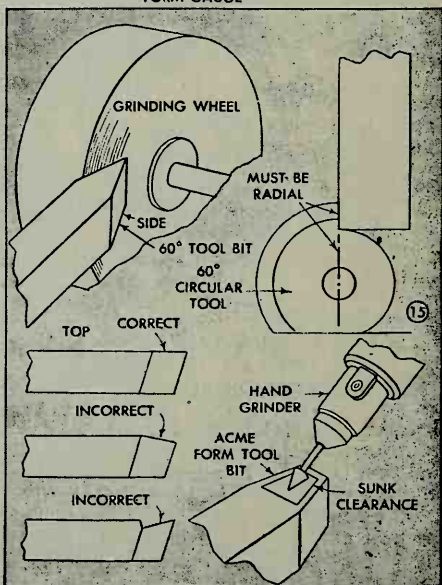
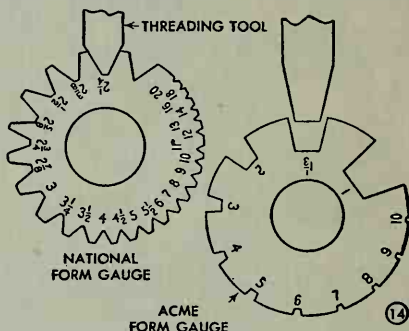
Threads Per Inch	American National (U. S. in inches)	Theoretical V Thread (in inches)
80	.0162	.0218
72	.0180	.0240
64	.0203	.0271
60	.0217	.0289
56	.0232	.0309
50	.0260	.0346
48	.0271	.0361
44	.0295	.0394
40	.0325	.0433
38	.0361	.0481
32	.0408	.0541
30	.0433	.0577
28	.0464	.0619
27	.0481	.0642
26	.0500	.0666
24	.0541	.0722
22	.0590	.0787
20	.0650	.0866
18	.0722	.0962
16	.0812	.1083
14	.0928	.1237
13	.0999	.1332
12	.1083	.1443
11½	.1130	.1506
11	.1181	.1575
10	.1299	.1732
9	.1443	.1925
8	.1624	.2165
7½	.1733	.2309
7	.1856	.2474
6	.2165	.2887
5½	.2367	.3149
5	.2598	.3464
4½	.2887	.3849
4	.3248	.4330
3½	.3712	.4949
3¼	.3997	.5329
	.4330	.5773

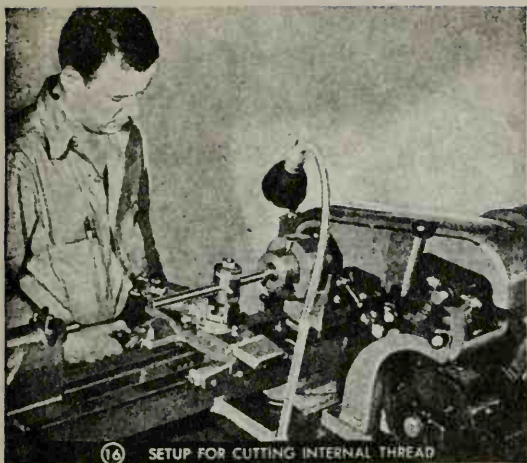
the lead is equal to the pitch, but when cutting a double thread, the lead is twice the pitch, as shown in the lower left-hand detail, Fig. 10.

Pitch diameter of a straight screw thread is equivalent to the diameter of an imaginary cylinder that would pass through the threads at points where the width of the threads would equal the width of the spaces between adjacent sides of the threads. This is illustrated in the right-hand detail of Fig. 10, which shows also the major and minor, or largest and smallest diameters of threads. When the major diameter is known, the minor diameter can be determined from the table, Fig. 12, which lists the double depth of threads from 3 to 80 per inch.

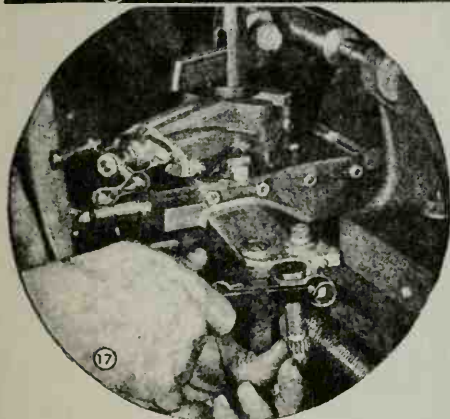
Various threading tools are illustrated in Fig. 11. The pointed tool A is used to cut V-threads, but can be used also to cut threads with a V-bottom, leaving the top flat. A screw cut in this manner will fit a National-form nut. This tool can be used to cut National-form threads when the point is ground to fit the proper slot of the gauge shown in the left-hand detail, Fig. 14. Tool B, Fig. 11, is used to cut Acme threads after grinding the point to fit the gauge shown in the right-hand detail of Fig. 14. Fig. 6 shows an Acme thread being cut. Tool bits like these must be carefully and repeatedly ground so that the angle is exactly right and allows enough side clearance to compensate for the rapid advance of the tool. Detail C, Fig. 11, shows a circular-type tool used for cutting external National-form threads, and Fig. 5 shows the tool in use. Internal threads are cut in the same way as external threads, except that tools of the type shown at D and E, Fig. 11, are used. Fig. 16 illustrates the cutting of an internal thread. In the case of internal threads, the bore of the hole becomes the minor diameter of the thread, and must be as accurately turned for concentricity as a shaft or spindle that is to be externally threaded.

Cutting tools can be ground more easily if gripped in a holder. The tool is held against the face of a wheel, Fig. 13, or against the side as in the upper left-hand detail of Fig. 15. The lower left-hand details show correctly and incorrectly ground tools for purposes of comparison. The circular-type tool is very easily ground against the side of the wheel, as in the upper right-hand detail of Fig. 15. The entire cutting surface of the tool must be kept flat on the wheel, its axis parallel with the wheel side. The Acme tool will



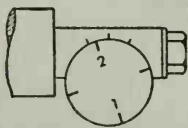


16 SETUP FOR CUTTING INTERNAL THREAD



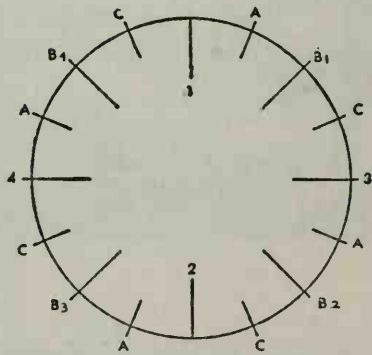
17

cut more easily if a slight clearance is ground in the face near the cutting edges, as indicated in the lower right-hand detail. The clearance should not, however, be closer to the edge than $\frac{1}{32}$ in.

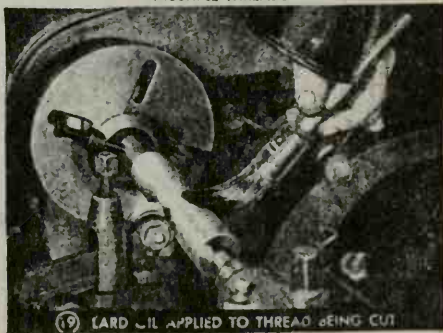


When all preparations have been made, the tailstock center is lubricated with some preparation such as white lead and sperm oil, graphite and tallow, or red lead and mineral oil to keep the center from heating excessively, and the work is positioned between lathe centers as in Fig. 1. It must not be removed from the centers until the thread is completely cut because it is almost impossible to recenter it in the original position. The compound rest is set at an angle of 29 deg., Fig. 17, and the tool is mounted in the tool post with the point of the tool exactly on the lathe-center line, Fig. 9, a center gauge being used to position the tool.

The threading dial, Fig. 18, is set by tightening a nut to engage a pinion against the lathe feed screw, as shown in Fig. 17, causing the dial to rotate with the feed screw. The purpose of the dial is to position the tool accurately in relation to the work so that after being withdrawn at the completion of a cut, the tool will return to the same starting place for the next cut, thus eliminating the necessity for reversing the direction of the carriage to return the tool after each cut. Standard threading dials are divided by four marks, as shown in the left-hand detail of Fig. 18, but additional marks may be provided, as in the right-hand detail, to suit exceptional threading operations. When cutting threads of 6, 8, 12 or any other even number per inch, the dial is engaged when any one of its four marks coincides with a stationary mark on the dial housing. If the

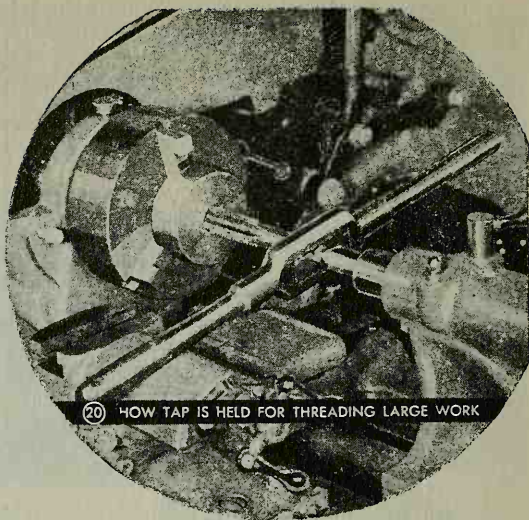


18 EXTRA MARKINGS FOR CUTTING MULTIPLE THREADS

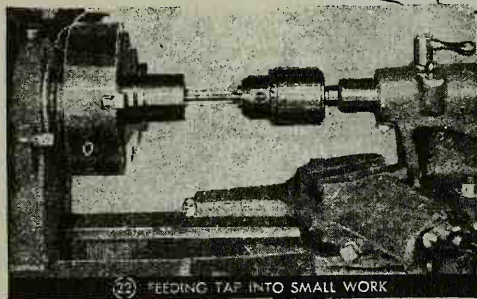


19 LARD OIL APPLIED TO THREAD BEING CUT

threads are odd numbered, the dial is engaged only when mark 1 or 2 is in line with the stationary mark. For half-numbered threads, such as those of $4\frac{1}{2}$, $5\frac{1}{2}$ or $7\frac{1}{2}$ per inch, the dial must be engaged at the same mark on each successive cut. A slow spindle speed is used in thread cutting, thereby assuring ample time to engage the dial at the proper mark, and lard oil is applied to the work after each cut, Fig. 19. The tool is always fed into the work with the compound. When feeding in the tool, the gauge mark on the compound must be noted so that cuts of suitable depth are taken. For roughing the thread in steel, the maximum depth of cut should be not over .005 in., and for the last two or three cuts, no more than .001 in. Heavier cuts may be taken on brass, bronze and aluminum. As the thread nears completion, it can be checked with a screw-pitch



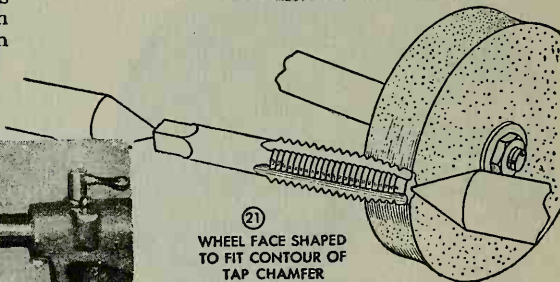
20 HOW TAP IS HELD FOR THREADING LARGE WORK



22 FEEDING TAP INTO SMALL WORK

gauge, Fig. 7. Left-hand threads are cut in the same way as right-hand threads, except that for left-hand cutting the carriage travels toward the tailstock and the compound rest is set at 29 deg. in the opposite direction.

For threading bores under 1 in. in diameter, taps are used instead of internal threading tools, as in these case taps are easier to use and will remove more metal in a given time than any other cutting tool that can be used for this purpose. If the bore is long, the work should be done on a lathe. In that event, the back gears are used for maximum driving power and minimum spindle speed. Taps under $\frac{1}{2}$ in. in diameter usually are gripped in a drill chuck that is held in the tailstock, Fig. 22. The

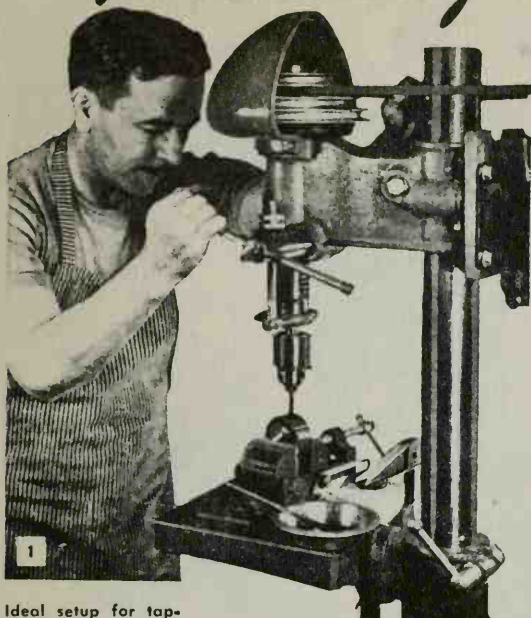


21 WHEEL FACE SHAPED TO FIT CONTOUR OF TAP CHAMFER

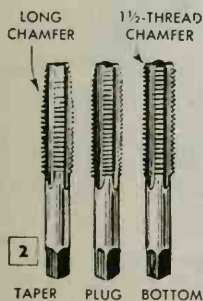
tailstock ram should be controlled so that its advance will correspond to that of the tap into the work. Large taps are gripped in a tap wrench and centered, with the wrench handle resting against the compound as in Fig. 20. The ram must be advanced gradually with a constant pressure to prevent breaking the tap. Taps should never be ground freehand if it is possible to use more reliable means. The only safe procedure is to hold the tap on centers that are positioned to keep the angle of the chamfer in line with the wheel face, Fig. 21. For best results, the wheel face should be concave to fit the contour of the chamfer. Each chamfer should be relieved to within $\frac{1}{16}$ in. of the cutting edge, and then oilstoned.

❏ Lacquer-enamel tints can be made by mixing tube colors in oil with clear lacquer, a procedure that is quite practical although lacquer and linseed oil ordinarily are not used together.

Threading with TAPS and DIES



Ideal setup for tapping can be made on drill press. Tap is turned by hand, by pulling on belt or by using tap wrench



HAND TAPS and dies provide a simple, fast method of cutting internal and external threads in metal or plastic. Even in shops where screw-cutting lathes are available, the faster method of threading with a hand tap or die is used almost universally for small diameters. Procedure is quite simple and precise work is easy to accomplish with the extensive range of sizes and supplemental data that are available on related tap-and-drill sizes and related systems. Tables No. 1 and 2, and the typical examples worked out below, show how to go about selecting a tap and the proper tap drill. They also show how to determine the correct thread system to use for the job at hand.

A practical setup for many tapping jobs can be made on the drill press. Drill the tap hole in the work and then chuck the tap to cut the thread. In this operation the important thing is to allow sufficient room to remove the drill and insert the tap without disturbing the setup. The spindle is turned by pulling on the belt by hand as in Fig. 1. The feed lever is held down with just sufficient pressure to overcome the tension of the quill spring. This method can be used with taps up to $\frac{1}{4}$ in., but larger tap sizes will require turning the chuck as in Figs. 3 and 5.

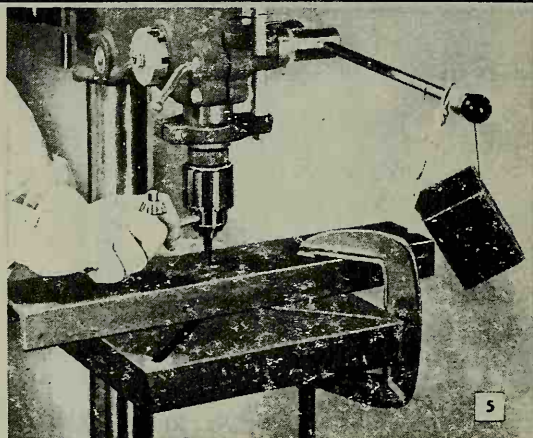
How to Use Tables

Example No. 1: Selecting tap when size of screw is not known. Measure diameter of screw as in Fig. 6. Assuming that it measures .137 in., run down third column in Table No. 1 to the nearest value which is .138 in. Note in the first column that this is the diameter of a No. 6 screw. Then check with a pitch gauge to determine the number of threads per inch. Common threads on a No. 6 screw are 32, 36 and 40. Thus a 6-32, 6-36 or 6-40 tap would be selected for the job. If 6-32 tap is required, run down first column in Table No. 1 to 6-32. Right-hand column shows No. 36 drill for 75% thread

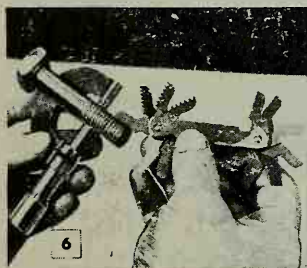




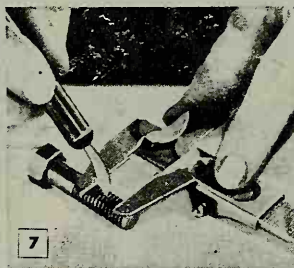
Although individual taps and dies can be purchased as you need them, it is better to obtain a standard tap-and-die set in the sizes most commonly used. Taps in the set can be ordered with either taper or plug ends as in Fig. 2, and the bottom taps for blind holes can be added as they are needed. Bottom taps are used to run the thread to the bottom of a blind hole. They are not used ordinarily in through holes. The taper tap is used instead, as it is easier to start, cuts freely and is easy to turn. When purchasing taps individually, keep in mind that machine taps cut threads for numbered machine screws while the hand taps cut threads of fractional-inch sizes.



When the chuck wrench is used to turn the chuck when tapping in drill press, attach a weight to the drill-press feed lever



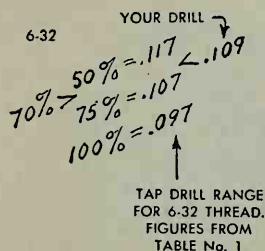
Thread diameter and pitch are determined with mike and pitch gauge



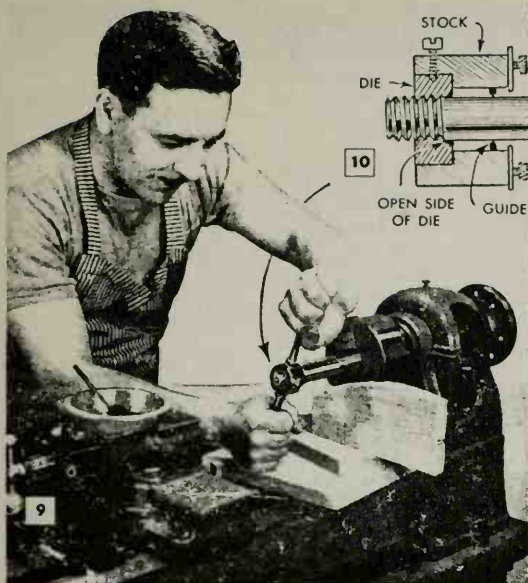
Without a pitch gauge, count the threads per inch or half inch



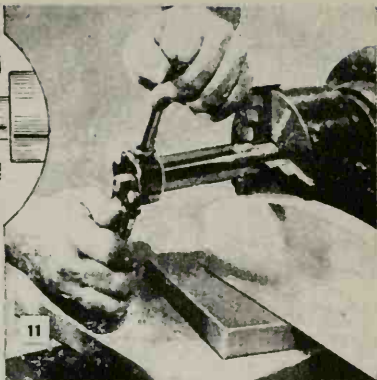
Lacking other means, determine size of internal thread with tap drill



Example No. 2: Same as Example No. 1 except that a No. 36 tap drill is not available. In Table No. 1 note that any size of drill between .097 in. and .117 in. in diameter can be used as a tap drill for a 6-32 tap. Consult Table No. 2 and locate drill in this size range. From this it can be seen that a 7/64-in. (fractional-size) drill is the size nearest to that required. In a decimal size this is about .109 in., and will give approximately a 70-percent thread as in the figures at left showing range of tap drills for a 6-32 thread

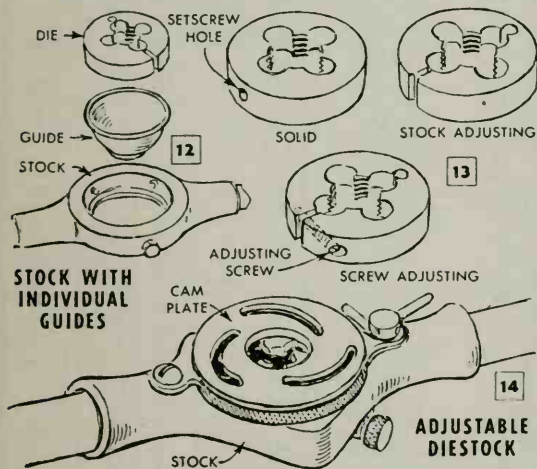


Threading with a round die held in a stock can be done in a lathe. Stock and die are reversed when threading to shoulder



When it is necessary to determine specific threads, a micrometer caliper and a screw-pitch gauge, Fig. 6, are required. Lacking the pitch gauge you can count screw threads per inch or half inch as in Fig. 7 and, when the length of the screw will permit, the tap also can be used as a gauge. On some internal threads where the mike and gauge cannot be used, one method is to check with drills as in Fig. 8, then determine the thread as explained in example No. 3 on the use of tables. Experienced machinists often can determine standard thread sizes accurately by eye alone. Also the nature of the job generally provides a fairly accurate clue. For example, in most machine assemblies N.C. (National Coarse) threads are commonly found. In automotive and airplane work N.F. (National Fine) threads are used, and on precision jobs and in instrument building N.F. or N.S. (National Special) threads are generally found.

Tap-drill sizes which will permit tapping 50, 75 and 100-percent threads are commonly used, Fig. 4. A 75-percent thread is a good



How to Use Tables

Example No. 3: In tapped holes too small to mike or check with a pitch gauge, insert drills until the hole stops a given size. Suppose, as an illustration, that the hole passes a $\frac{3}{32}$ -in. (.094) drill but stops a $\frac{7}{64}$ -in. (.109) drill. It is reasonably accurate to estimate the size of the hole as .105 in. which would be the tap-drill size used originally. Using the figures at the left, locate the nearest values in the 75-percent column in Table No. 1. With these it is possible to determine the thread size required



$\frac{3}{32}$ (.094) passes
 $\frac{7}{64}$ (.109) a little big
 Estimated at .105
 Could be
 5-44-.102
 6-32-.107

TABLE No. 1

THREADS and TAP DRILL SIZES

TAP or SCREW	THREAD SYSTEM	OUTSIDE DIA.	TAP DRILL			DRILL for 75%	TAP or SCREW	THREAD SYSTEM	OUTSIDE DIA.	TAP DRILL			DRILL for 75%
			50%	75%	100%					50%	75%	100%	
0-80	N.F.	.060	.052	.048	.044	3/64	7/32-24	N.S.	.219	.192	.178	.164	16
1/16-64	N.S.	.063	.052	.047	.042	3/64	32	N.S. *	.219	.199	.188	.178	12
72	Obs.	.063	.054	.049	.044	3/64	32	Stave	.222	.198	.186	.174	16
1-56	N.S.	.073	.061	.055	.050	54	15/64-24	N.S.	.234	.207	.194	.180	10
64	N.C.	.073	.063	.058	.053	53	14-20	N.S.	.242	.210	.193	.177	10
72	N.F.	.073	.064	.060	.055	53	24	N.S.	.242	.215	.201	.187	7
5/64-60	N.S.	.078	.067	.061	.056	1/16	1/4-18	Stave	.250	.224	.211	.198	8
72	Obs.	.078	.069	.065	.060	52	20	N.C.	.250	.218	.201	.185	7
2-56	N.C.	.086	.074	.068	.063	50	24	N.S.	.250	.223	.209	.195	4
64	N.F.	.086	.076	.071	.066	50	27	N.S.	.250	.226	.213	.201	3
3/32-48	N.S.	.094	.080	.073	.066	49	28	N.F.	.250	.227	.215	.203	3
50	Obs.	.094	.081	.074	.067	49	32	N.S.	.250	.230	.220	.209	7/32
3-48	N.C.	.099	.086	.079	.072	47	5/16-18	N.C.	.312	.276	.258	.240	F
56	N.F.	.099	.087	.081	.076	45	20	N.S.	.312	.280	.263	.247	17/64
7/64-48	N.S.	.109	.096	.089	.082	43	24	N.F.	.312	.285	.272	.258	I
4-32	N.S.	.112	.092	.081	.071	45	27	N.S.	.312	.288	.276	.264	J
36	N.S.	.112	.094	.085	.076	44	32	N.S.	.312	.292	.281	.271	9/32
40	N.C.	.112	.096	.088	.080	43	3/8-16	N.C.	.375	.334	.313	.293	5/16
48	N.F.	.112	.098	.091	.085	42	20	N.S.	.375	.343	.326	.310	21/64
1/8-32	Stave	.125	.108	.099	.091	42	24	N.F.	.375	.348	.334	.320	Q
32	N.S.	.125	.105	.094	.084	3/32	27	N.S.	.375	.351	.338	.326	R
40	N.S.	.125	.109	.100	.092	38	7/16-14	N.C.	.437	.391	.368	.344	U
5-36	N.S.	.125	.107	.098	.089	40	20	N.F.	.437	.405	.388	.372	25/64
40	N.C.	.125	.109	.100	.092	38	24	N.S.	.437	.410	.397	.383	X
44	N.F.	.125	.110	.102	.095	37	27	N.S.	.437	.413	.401	.389	Y
6-32	N.C.	.138	.117	.107	.097	36	1/2-12	N.S.	.500	.446	.419	.391	27/64
36	N.S.	.138	.120	.110	.101	34	13	N.C.	.500	.450	.425	.400	27/64
40	N.F.	.138	.122	.113	.105	33	20	N.F.	.500	.467	.451	.435	29/64
9/64-40	N.S.	.141	.124	.116	.108	32	24	N.S.	.500	.473	.459	.445	29/64
7-30	N.S.	.151	.129	.118	.107	31	27	N.S.	.500	.476	.463	.451	15/32
32	A.S.M.E.	.151	.131	.120	.110	31	9/16-12	N.C.	.562	.508	.471	.454	31/64
36	N.S.	.151	.133	.124	.114	1/8	18	N.F.	.562	.526	.508	.490	33/64
5/32-32	N.S.	.156	.136	.125	.115	1/8	27	N.S.	.562	.538	.526	.514	17/32
36	N.S.	.156	.138	.129	.120	30	5/8-11	N.C.	.625	.566	.536	.506	17/32
28	Stave	.163	.144	.135	.125	1/8	12	N.S.	.625	.571	.544	.516	35/64
8-30	N.S.	.164	.142	.131	.120	30	18	N.F.	.625	.589	.570	.552	37/64
32	N.C.	.164	.144	.133	.123	29	27	N.S.	.625	.601	.588	.576	19/32
36	N.F.	.164	.146	.137	.127	29	11/16-11	N.S.	.687	.629	.599	.569	19/32
40	N.S.	.164	.148	.139	.131	28	16	N.S.	.687	.647	.626	.606	5/8
11/64-32	N.S.	.172	.152	.141	.131	9/64	3/4-10	N.C.	.750	.685	.652	.620	21/32
9-24	N.S.	.177	.150	.136	.122	29	12	N.S.	.750	.696	.673	.641	43/64
30	N.S.	.177	.155	.144	.133	27	16	N.F.	.750	.709	.688	.668	11/16
32	N.S.	.177	.157	.146	.136	26	27	N.S.	.750	.726	.713	.701	23/32
3/16-24	N.S.	.187	.160	.147	.133	26	13/16-10	N.S.	.812	.748	.715	.682	23/32
32	N.S.	.187	.167	.156	.146	22	7/8-9	N.C.	.875	.803	.766	.730	49/64
24	Stave	.195	.173	.162	.151	24	12	N.S.	.875	.821	.793	.766	51/64
10-24	N.C.	.190	.163	.149	.135	25	14	N.F.	.875	.829	.806	.782	13/16
28	N.S.	.190	.167	.155	.143	23	18	N.S.	.875	.839	.820	.802	53/64
30	N.S.	.190	.168	.157	.146	22	27	N.S.	.875	.851	.838	.826	27/32
32	N.F.	.190	.170	.159	.149	21	15/16-9	N.S.	.937	.865	.829	.793	53/64
13/64-24	N.S.	.203	.176	.163	.149	20	1-8	N.C.	1.000	.919	.878	.837	7/8
12-24	N.C.	.216	.189	.175	.161	16	12	N.S.	1.000	.946	.918	.891	59/64
28	N.F.	.216	.193	.181	.169	14	14	N.F.	1.000	.954	.931	.907	15/16
32	N.S.	.216	.196	.185	.175	13	27	N.S.	1.000	.976	.963	.951	31/32

N.C.—National Coarse (formerly U.S.S.)

N.F.—National Fine (formerly S.A.E.)

N.S.—National Special (various threads from older systems)

Stave—Stave bolts, Manufacturers Standard

A.S.M.E.—American Society of Mechanical Engineers. Most threads in this older system are included in the National system.

TABLE No. 2

DRILL SIZES

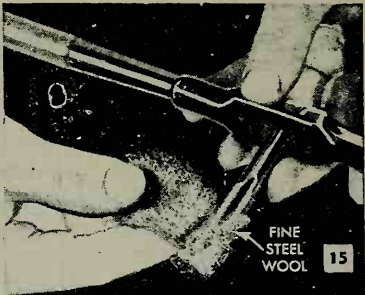
INCH	DECIMAL	WIRE	INCH	DECIMAL	WIRE	INCH	DECIMAL	WIRE or LETTER	INCH	DECIMAL	LETTER
1/64	.014	80		.089	43		.199	8	25/64	.390	
	.015	79		.093	42		.201	7		.397	X
	.016		3/32	.094		13/64	.203			.404	Y
	.016	78		.096	41		.204	6	13/32	.406	
	.018	77		.098	40		.205	5		.413	Z
	.020	76		.099	39		.209	4	27/64	.422	
	.021	75		.101	38		.213	3	7/16	.437	
	.023	74		.104	37	7/32	.219		29/64	.453	
	.024	73		.106	36		.221	2	15/32	.469	
	.025	72	7/64	.109			.228	1	31/64	.484	
1/32	.026	71		.110	35		.234	A	1/2	.500	
	.028	70		.111	34	15/64	.234		33/64	.515	
	.029	69		.113	33		.238	B	17/32	.531	
	.031	68		.116	32		.242	C	35/64	.547	
	.031			.120	31		.246	D	9/16	.562	
	.032	67	1/8	.125		1/4	.250	E	37/64	.578	
	.033	66		.128	30		.257	F	19/32	.594	
	.035	65		.136	29		.261	G	39/64	.609	
	.036	64		.140	28	17/64	.265		5/8	.625	
	.037	63	9/64	.141			.266	H	41/64	.640	
3/64	.038	62		.144	27		.272	I	21/32	.656	
	.039	61		.147	26		.277	J	43/64	.672	
	.040	60		.149	25		.281	K	11/16	.687	
	.041	59		.152	24	9/32	.281		45/64	.703	
	.042	58		.154	23		.290	L	23/32	.719	
	.043	57	5/32	.156			.295	M	47/64	.734	
	.046	56		.157	22	19/64	.297		3/4	.750	
	.047			.159	21		.302	N	49/64	.766	
	.052	55		.161	20	5/16	.312		25/32	.781	
	.055	54		.166	19		.316	O	51/64	.797	
1/16	.059	53		.169	18		.323	P	13/16	.812	
	.062		11/64	.172		21/64	.328		53/64	.828	
	.063	52		.173	17		.332	Q	27/32	.844	
	.067	51		.177	16		.339	R	55/64	.859	
	.070	50		.180	15	11/32	.344		7/8	.875	
	.073	49		.182	14		.348	S	57/64	.891	
	.076	48		.185	13		.358	T	29/32	.906	
	.078		3/16	.187		23/64	.359		59/64	.922	
	.079	47		.189	12		.368	U	15/16	.937	
	.081	46		.191	11	3/8	.375		61/64	.953	
5/64	.082	45		.193	10		.377	V	31/32	.969	
	.086	44		.196	9		.386	W	63/64	.984	

average for hand tapping but in machine tapping 50 to 60-percent threads are common. Cutting a 100-percent thread requires extremely careful work with a hand tap to avoid breakage of the tap and damage to the thread. When joining pipe in mechanical assemblies a 50-percent tap drill is commonly used. An example of this is the use of a 3/8-in. drill for a 50-percent thread in 1/2-in. pipe as in Table No. 3. If a free-running thread is required, mechanics sometimes use steel wool, as in Fig. 15, to cut the thread slightly oversize. First the hole is tapped in the usual manner, then the tap is withdrawn and wrapped with one full turn of fine steel wool. After the tap is restarted in the threaded hole, it is turned in to its full length. The steel-wool wrapping in effect "rolls" the thread to a slightly larger diameter.

Thread-cutting dies take the place of the screw-cutting lathe for ordinary work in both large and small shops where accurate duplication is not required. Frequently the work involves a turning or shouldering operation in the lathe and here the lathe can be used as a holding device for starting the die, Fig. 9. Corners of squared work should be broken to permit the die to start readily. Note when using ordinary round dies of the split type that the threads are chamfered from one side of the die. Always start the die from the chamfered side as in Fig. 10 and when a die holder, or stock, is used as in Fig. 11, where the thread is to be run up to a shoulder, the die is reversed in the stock.

The various types of common round dies are shown in Figs. 12, 13 and 14. The inexpensive solid die is suitable for average work but either the stock-adjusting or screw-adjusting die should be used where any variation in the thread may be required. Fig. 16 pictures a plug tap being started with the aid of a wooden guide, and Fig. 18 shows how to use a piece of tape as a depth stop. Machine screws, in Fig. 17, can be made from wood screws.

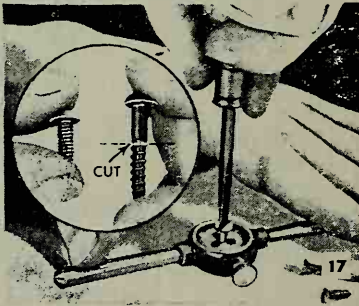
★ ★ ★



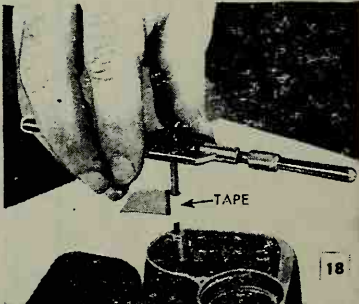
Steel wool forms free-running thread



Start plug tap through wooden guide



Make machine screws of wood screws



Adhesive tape can serve as depth stop

Straight and Taper PIPE THREADS

TABLE No. 3

Pipe Size	Threads per Inch	Actual Outside Dia.	Outside Of St. Thread	TAP DRILL			Regular Tap Drill
				50%	75%	100%	
1/8"	27	.405	.404	.375	.360	.345	11/32
1/4"	18	.540	.534	.490	.467	.445	7/16
3/8"	18	.675	.671	.627	.604	.582	37/64
1/2"	14	.640	.835	.778	.749	.721	23/32
3/4"	14	1.050	1.046	.989	.960	.932	59/64
1"	11 1/2	1.315	1.308	1.239	1.204	1.169	1-5/32
1 1/4"	11 1/2	1.660	1.653	1.583	1.549	1.514	1-1/2
1 1/2"	11 1/2	1.900	1.892	1.822	1.788	1.753	1-47/64
2"	11 1/2	2.375	2.366	2.296	2.262	2.227	2-7/32

Tap-drill size in right-hand column permits full thread for straight or taper tap. Plumbing requires taper tap

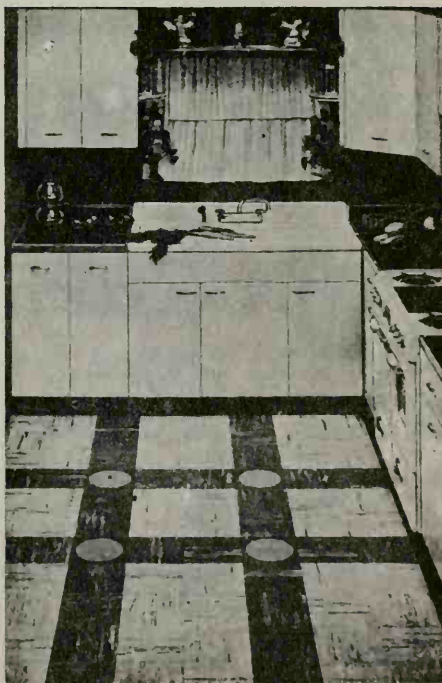


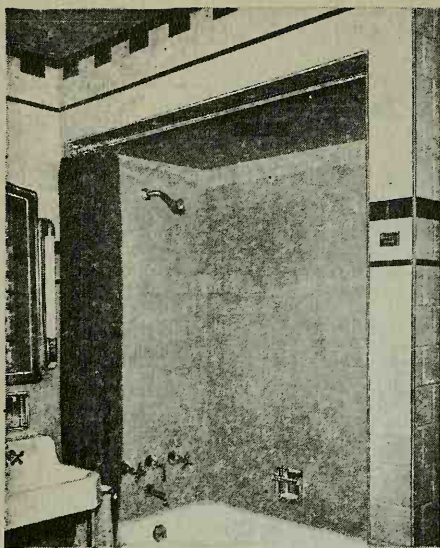
TILING WALLS AND FLOORS

LIKE THE MAGICIAN who makes a drab stick burst into a beautiful flower right before your eyes, you, too, can make your kitchen or bathroom "burst into bloom" by using modern wall and floor coverings. When their permanency and ease of cleaning are considered, these coverings are relatively inexpensive, especially if you install them yourself. Individual tiles, panel board and flexible wall coverings are available in an endless array of colors and designs to suit your tastes and pocketbook. The more common wall coverings include plastic and metal tile, enamel-surface and plastic-type flexible coverings, and predecorated panel board. For floors, there are asphalt, rubber and cork tiles in countless color combinations.

Plastic and metal tile: To estimate the amount of tile required, figure the area in square feet and add five percent for waste. Then measure the amount of trim needed. If you wish to stagger the field tile, as in Fig. 2, remember that a half tile is used to start alternate rows. The only tools needed are a carpenter's level, straightedge, putty knife, trowel having a saw-tooth edge, and a coping saw. A shear-type tile cutter, which frequently can be rented from your tile dealer, will speed the work of cutting.

To prepare the room, remove baseboards,





Tiled bathroom, above, is example of what can be done by including your personal ideas on decoration



STAGGERED JOINTS



STRAIGHT JOINTS



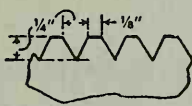
DIAGONAL PATTERN



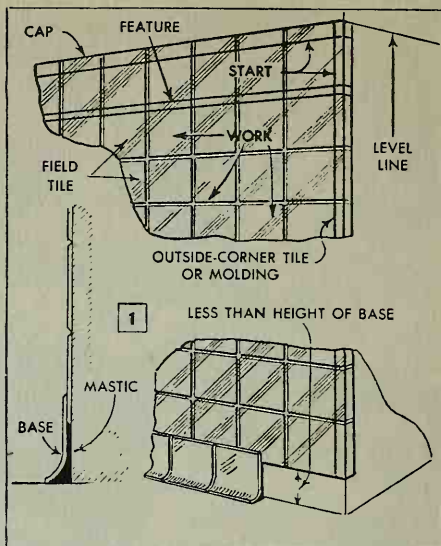
CAP, FEATURE AND BASE MAY BE STAGGERED



TROWEL MASTIC WITH WAVY MOTION



BUTT EDGES OF TILE AND SNAP IN PLACE

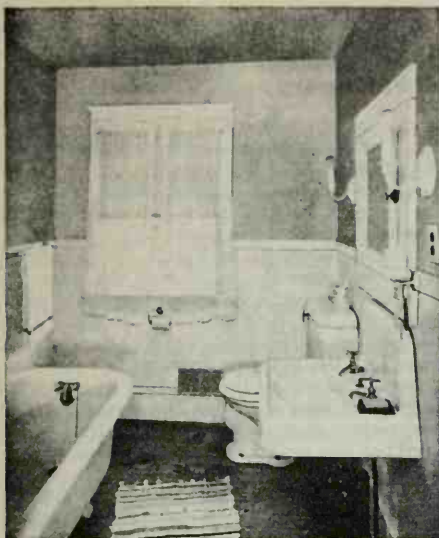


moldings and fixtures. Soak off all wallpaper, remove calcimine and scrape off loose paint. As a smooth wall and strong bond are essential, remove any weak or broken plaster and patch these areas as well as any holes or cracks. All surfaces, whether plaster, wallboard or plywood, should be sealed thoroughly to assure proper adhesion of the mastic used to bond the tile to the wall. A putty knife, notched in the same way as the trowel will come in handy for applying mastic in narrow areas. Dimensions for cutting the notches are given in Fig. 2.

Before installing the tile, snap a chalk line completely around the room, leveling it along each wall. To locate the height of the line (either for a cap strip or merely as a guide line), measure from the lowest point of the floor or, in a bathroom installation, from the top of the bathtub. This is done to avoid laying small pieces of tile along the top of the tub. If you intend to use individual base tile, locate the level line so the bottom row of tile will extend somewhat below the top of the base tile, Fig. 1, and fill the space between the base and the wall with mastic. If using a strip-type plastic base, carry the field tile to the floor line, trimming the bottom row, and install the base directly over the tile.

The mastic, which should be at room temperature, is mixed thoroughly and applied to the wall in a layer about $\frac{1}{16}$ in. thick, spreading it with the saw-tooth trowel in a sharp, wavy motion. Don't spread the mastic over more wall area than you can cover with tile in about $\frac{1}{2}$ hour.

Except in the case of the interlocking



Left-hand photo shows bathroom before modernizing with panel board; photo at right, the transformation

type of tile, which is applied from the bottom of the wall upward, start with the cap strip or with a row of tile at the level line, and then install the outside-corner tiles or molding. Work downward and away from the outside corner, as in Fig. 1. Apply each tile by placing one edge against the adjacent tile. Then snap it into the mastic as in Fig. 2, pressing firmly on the corners, but not on the center. Pointing (making an even line of mastic in the joints between the tiles) is optional. However, this is recommended where the tiled wall is subjected to excessive amounts of water, such as in a shower stall, and can be done with the finger tip, pointing stick or a pencil eraser. Pointing and cleaning off of excess mastic should be done as tiling progresses. Allow the base tile to follow the floor line and carefully seal the top and bottom joints with plenty of mastic.

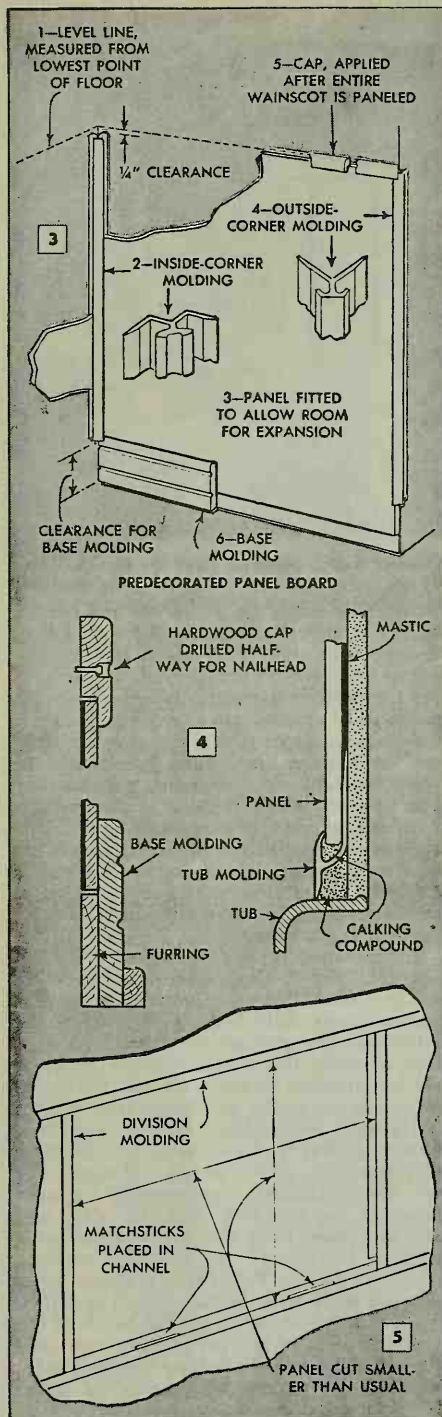
If built-in fixtures are to be installed, cut the openings for them before laying the tile, which then is cut to fit around the openings. Install the fixture after tiling. Drill through the tile and fasten screw-on fixtures directly to the wall—never fasten anything to the tile itself.

For straight cuts use a standard tile cutter, tin snips, or a fine-tooth saw. To fit the tile around pipes or fixtures, cut it with a coping saw. The tile should not be washed or polished for at least two weeks after installation in order to give the mastic time to harden thoroughly. Do not attempt to clean the tile with gasoline, acetone, turpentine or any chemical of doubtful effect.

Predecorated panel board: This material

is available in panels 4 ft. wide and from 4 to 12 ft. long, and also is applied with a mastic-type adhesive. The board can be obtained in plain colors, scored in tile patterns, or scored horizontally only. It also is available in wood-grain or marble patterns. Moldings to meet every conceivable need can be had in aluminum, hardboard or stainless steel. In basement installations, it is best to dampproof the walls and furl them out before applying panel board. The walls are prepared and sealed in much the same way as for plastic tile. Again, draw a level line around the room and, if a vertical treatment from floor to ceiling is to be used, establish a plumb line.

For a wainscot job utilizing a hardboard cap, as in Fig. 3, allow $\frac{1}{4}$ -in. clearance below the level line when installing the corner moldings. Also leave clearance at the bottom for the base molding. If the panel is long enough, the outside-corner molding can be attached to the wall and the panel sprung between the moldings. However, if the section of panel is too short to permit springing, slip the outside-corner molding over the edge of the panel and apply the two simultaneously, nailing the exposed flange of the molding. The cap strip and base are fitted after the entire wainscot is paneled. Hardboard cap and base molding are applied as in Fig. 4, the corners being mitered. Note that the hardboard is drilled about halfway through for the heads of the finishing nails to prevent splitting, and that the lower portion of the base molding is reinforced by furring with scraps of panel board or wood. Fig. 4 also details a bathtub



installation, using a standard tub molding.

Even though the corners of the room are out of plumb, cut the panel board to fit into them. The upper detail of Fig. 8 shows the correct way of fitting a panel, allowing a clearance of about $\frac{1}{16}$ in. along each molding. This permits expansion and shifting of the panel without buckling. To be sure that proper clearance is allowed, temporarily fit the panel tightly in the molding and draw a pencil mark on the panel along the edge of the molding, as in Fig. 9. Then, allow $\frac{1}{16}$ in. between the mark and the edge of the molding when installing the panel permanently. Fig. 8 shows how to bevel the back edges of the panels to aid in slipping them into the molding channels.

Apply mastic to the backs of the panels with a notched spreader recommended by the panel manufacturer. Use the level line, not the molding, as a guide when installing the panels. Knead and press the panels against the wall with your hands until you can "feel" the mastic bond. It's a good idea to nail the bottom of the panel to the wall, driving the nails into the studs. Locate the nails so they will be covered by the base molding and do not drive them too tightly, as this is likely to give the panel a wavy appearance. If there is any doubt about the panel holding to the wall, brace it until the mastic sets. The braces can be extended diagonally from floor to wall or across the room, as in Fig. 6. Brace with just enough tension to hold the panels against the wall and protect the panels by wrapping the braces with cloth or paper, as shown.

To panel the entire room, follow the same general procedure, using division molding instead of the cap strip. Nail outer edges of ceiling panels, covering the nails with cove molding, and prop the panels in place. Fitting horizontal aluminum molding between vertical moldings is done as in Fig. 7.

There's a trick to replacing a panel after the installation has been completed. Cut the panel slightly undersize and place two or more matchsticks in the channel of the lower horizontal molding, Fig. 5. Then, after applying mastic, slip the panel tightly into the channels of the molding at the top and one side so the bottom and opposite side of the panel will clear the face of the molding. Finally, rest the panel on the matchsticks, slide it sideways so all edges engage the moldings and press it against the wall.

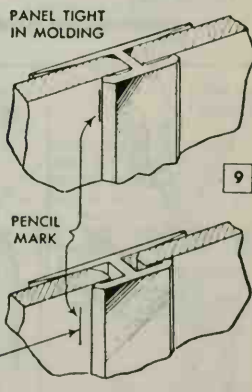
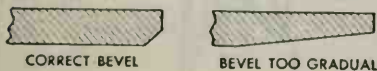
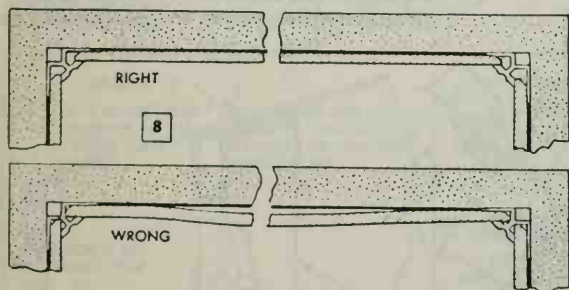
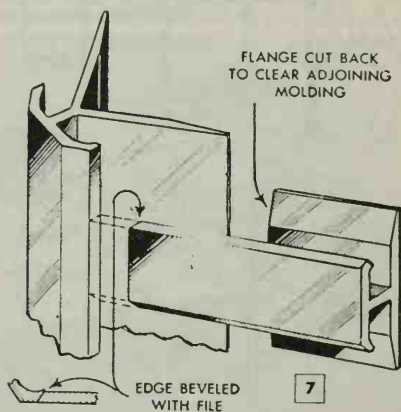
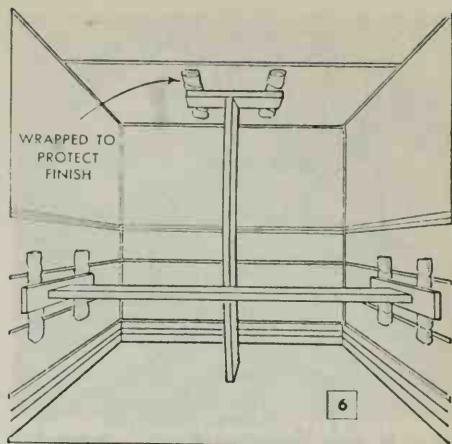
Flexible wall coverings: Both the enamel-surface and plastic-type coverings are purchased in roll form. For satisfactory results, they should be applied only to a smooth, dry wall surface and not to walls in direct contact with the ground or weather unless the walls have been furred out. Cracks and breaks in plaster should be patched and sanded, seams of dry walls

taped, and all porous surfaces sealed or sized. After the adhesive is applied to the wall, the covering is placed over the adhesive and worked with a wall roller to eliminate air bubbles.

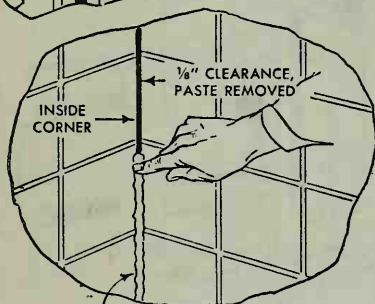
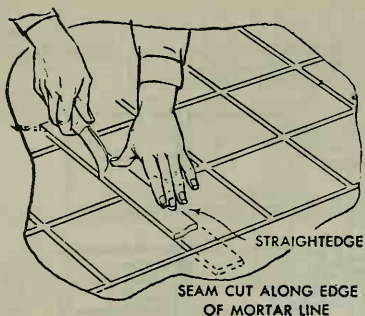
Enamel-surface coverings usually are installed horizontally using a level line as a guide. The joints are butted, with the seams cut prior to hanging as in the upper detail, Fig. 10. Final trimming can be done on the wall as in the center detail. Although metal moldings are available, a neat inside corner can be made, as in the lower detail, by allowing a slight clearance between adjacent sheets and filling the gap with a non-shrinking crack filler tinted to match the mortar lines in the material.

The plastic-type covering is hung vertically, using a plumb line as a guide, and can be formed around both outside and inside corners. For inside corners, the covering should be creased before hanging. The sheets are overlapped and the seams cut on the wall as in the right-hand detail, Fig. 11, the straightedge being necessary to prevent stretching of the material. Because of the resiliency of the plastic-type covering, it can be fitted around fixtures by creasing with a putty knife, as in the left-hand detail, and then trimming with a linoleum knife. A recommended method for insuring a watertight seal around a bathtub is detailed in Fig. 12. Note that a 3-in. strip of waterproof plywood is coated with spar varnish and set in calking compound between the lower edge of the plaster and the tub. The joint between the plywood and plaster is taped and sanded, and cove molding is used around the top of the tub.

Tiling floors: Colorful, long-wearing



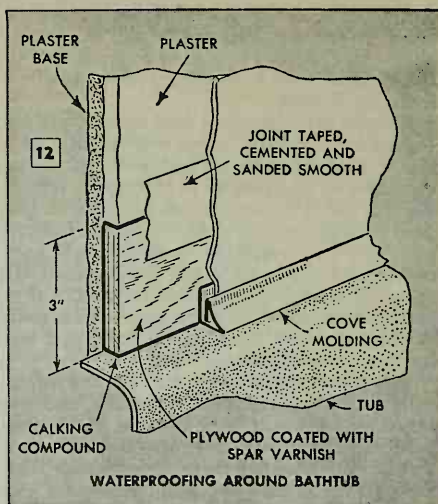
SLIDE PANEL OUT UNTIL MARK IS $\frac{1}{16}$ " FROM MOLDING



CRACK FILLER, SAME COLOR AS MORTAR LINES

10

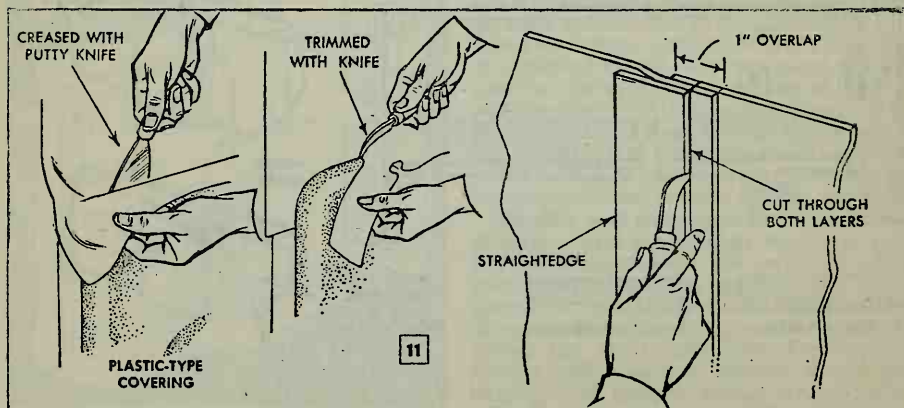
ENAMEL-SURFACE COVERING



Courtesy Congoleum-Nairn, Inc., and The Tahoe Corp.

floors of resilient tile can be yours for less than you might think, and installing the tile is not nearly so difficult as the eye-catching results would make it seem. Asphalt tile is an all-purpose floor covering that is inexpensive and easy to maintain and, as the coloring extends through the entire thickness of the tile, normal wear is unnoticeable. In addition to the color and wearing quality of asphalt tile, rubber tile features extra resiliency. Both tiles are available in a wide selection of interesting colors that affords endless design possibilities. Harmonizing base molding, feature strips and special insert designs are available in rubber and asphalt tiles. Cork tile, in its natural color, forms a beautiful, durable floor covering that is extremely quiet underfoot.

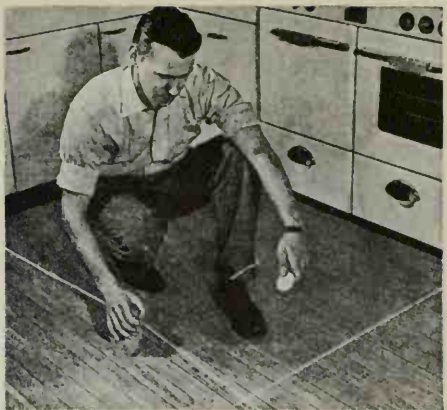
Asphalt tile can be used in any room of the house, and is especially suited to basement recreation rooms and workshops, as



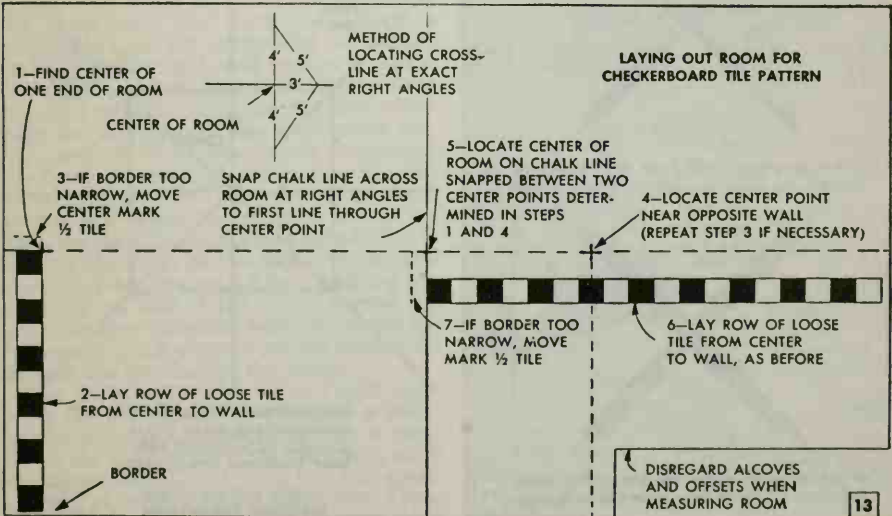
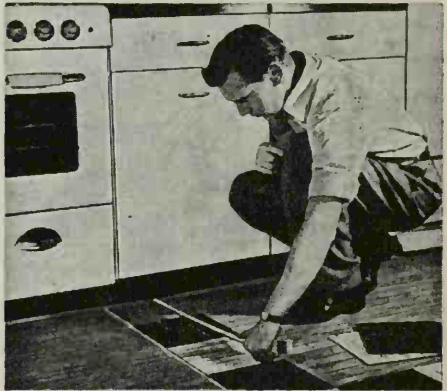
it can be laid on concrete which is in direct contact with the ground. Rubber tile also is suitable for use throughout the house, with the exception that it should not be laid on a concrete floor of a basementless house unless there is a crawl space under the floor. This also applies to cork tile, which lends itself especially well to living rooms, bedrooms and bathrooms, but is not recommended for installation in kitchens, foyers or utility rooms.

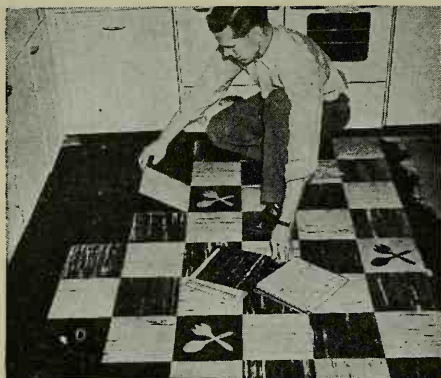
Particularly on new construction, it is imperative to check a concrete floor for dampness before laying rubber or cork tile. A simple moisture test can be made by forming a ring of putty, about 1/2 in. deep and 3 in. in diameter, on the floor and then sprinkling 1/4 teaspoonful of dry calcium chloride in the center of the ring. Press a sheet of clear glass over the putty ring to keep outside air from coming in contact with the calcium chloride. If the calcium chloride is still white and dry after eight hours, the floor is sufficiently free from moisture to permit laying the tile.

A smooth, clean surface is essential for installing all types of resilient tile. The subfloor must be free from grease, wax and loose paint and, of course, all old floor coverings should be removed. Fill holes and smooth out uneven spots in concrete floors with a special patching material available from the tile manufacturer. For satisfactory results when installing tile on a wooden floor, be sure there is at least 24 in. of well-ventilated air space between the ground and the floor joists. Nail down all loose boards, replace any broken ones and, if the floor boards are over 3 in. wide, badly worn or there is no subfloor under the

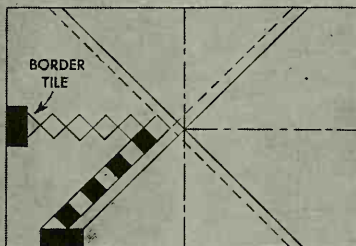


Snapping chalk line through center points of room, above, forms guide lines for tile. Below, measuring to make sure border will be over a half tile wide

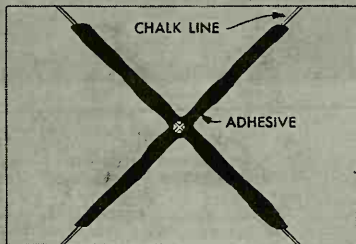




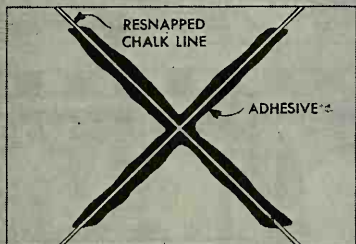
After adhesive is applied to first half of room, tile is laid by working outward from center point



Lay rows of tile to adjacent walls and relocate diagonal lines $\frac{1}{2}$ tile, if necessary



Cover diagonal chalk lines with adhesive, leaving the ends and intersection exposed



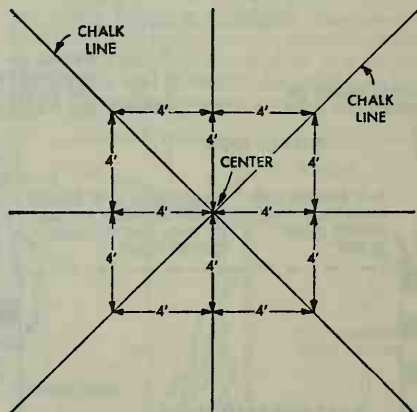
When adhesive strips become tacky, carefully resnap chalk lines over the adhesive

14

boards, apply an underlayer of plywood or special hardboard over the floor. Both rubber and cork tile can be cemented directly to the underlayer, but if the latter is not used, a layer of asphalt-saturated felt should be cemented to the floor before laying these tiles.

After preparing the floor, the next step is to mark off the room so that the tile can be laid true regardless of the irregularity of the walls. This is done as shown in Fig. 13, which describes the checkerboard pattern. This method is a basic one used for all patterns in which the tile runs parallel with the walls. The layout for a diagonal pattern is made simply by extending diagonal lines from the center of the room, Fig. 15, after the center has been located in the same way as for the checkerboard pattern. Note in Figs. 13 and 14 that test rows of loose tile are laid from the center point to the walls to check the width of the border. If the test indicates that the border will be less than a half tile wide, the chalk lines are relocated a half tile. When using a diagonal pattern with two contrasting tile colors, it is best that the half tile butted against the border contrast with the color of the border tile.

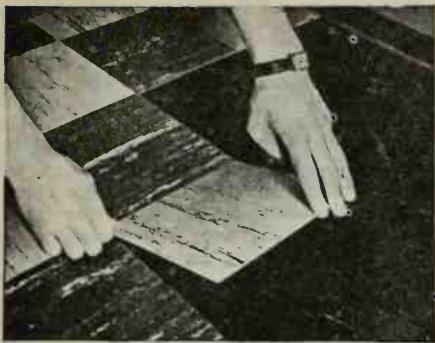
Spread adhesive over the final chalk lines with a notched trowel, leaving the intersection and ends of the lines exposed, as in the center detail, Fig. 14. When the adhesive becomes tacky (about $\frac{1}{2}$ hour), resnap the chalk lines. Next, without covering the chalk lines, spread adhesive over half of the room. Even though it may take from $\frac{1}{2}$ to 4 hours, allow the adhesive to become tacky before laying the tile. Test



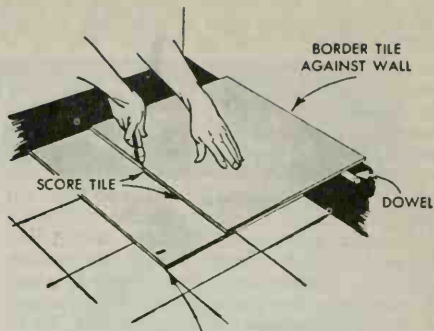
FIND CENTER OF ROOM AS FOR CHECKERBOARD, MARK OFF 4' SQUARES FROM CENTER AND SNAP DIAGONAL CHALK LINES

LAYING OUT ROOM FOR DIAGONAL TILE PATTERN

15



Edge of tile is held firmly against adjacent piece, as above, and tile is lowered into adhesive. Sliding tile into place causes adhesive to ooze from joints

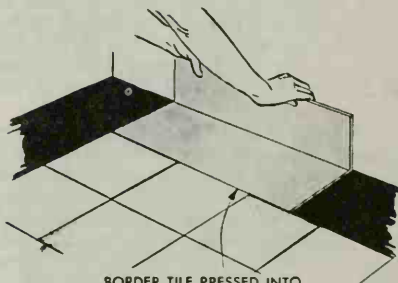


BORDER TILE PLACED ALONG SECOND SEAM OF FIELD TILE

the adhesive by pressing it with your finger. If the adhesive does not stick to the finger, you can begin laying the tile. There's no hurry, as the adhesive can remain on the floor for two or three days, if necessary, before the tile is laid. Spreading the adhesive evenly over the floor is extremely important. The adhesive never hardens, and if it is too thick in spots it will ooze up through the tile seams. In addition, a layer of adhesive that is spread evenly but too thickly will produce a cushion under the tile so that furniture legs and casters will cause depressions in the tiled floor. On the contrary, a tile which is not cemented completely may crack after it is on the floor only a short time. For best results, use the notched trowel specified by the tile manufacturer and bear down hard on the trowel when spreading the adhesive.

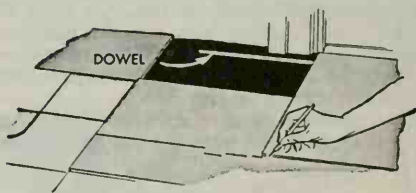
Start laying the tile at the intersection of the chalk lines and work outward in a semicircle from the center line toward the walls. Be sure that each course of tile is started exactly on the chalk line to keep the rows straight. In laying the tiles, alternate the direction of the marbled pattern, and carefully place each succeeding tile firmly in the angle formed by the two adjacent tiles. Don't slide the tile in place, as this will cause the adhesive to ooze up from the joint. Instead, place the tile firmly against the edge of the adjacent tile and lower it into position. After finishing the field tile on half of the room, spread the adhesive over the other half. While the adhesive is drying, you can lay the border tile around the first half of the room.

The three upper details in Fig. 16 illustrate the method of installing 18 x 24-in. border tile when 9 x 9-in. field tile is used. Score the border tile with the grain, as in the upper detail, and snap the tile apart, starting at one end of the score line. Then, sand off the burr along the snapped edge

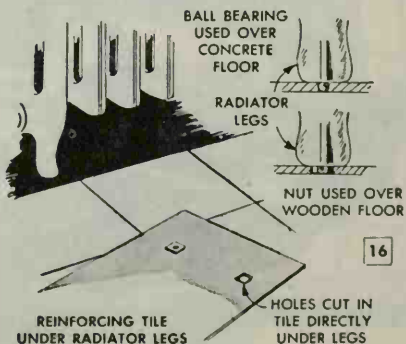


BORDER TILE PRESSED INTO ADHESIVE ALONG WALL WITH SECOND PIECE OF BORDER TILE

INSTALLING BORDER TILE



MARKING BORDER TILE TO FIT AROUND DOOR CASING



and lay the tile in the adhesive. Fitting border tile around door trim is done by using a second piece of border tile as a straightedge for transferring the irregular contour to the tile being fitted. Keep the straightedge parallel with the tile being marked, and score the tile at the widest point marked. Snap off the tile along the straight score line, heat the back of the tile with a blowtorch until pliable, and then cut the tile with a linoleum knife, following the contour marks. If you are using field tile instead of the larger tile for the border, which is sometimes recommended, place the tile to be marked along the first instead of the second seam of the field tile. To fit the tile around pipes and radiator legs, mark the tile, heat in the same way as above and cut to fit. If a radiator can be raised, slip the tile under the legs, first reinforcing the tile with a nut, washer or ball bearing as shown in the lower detail, Fig. 16. Otherwise, the heat from the radiator will soften the tile and the weight will crack the tile around the legs.

Both cork and rubber tile are installed in much the same way as the asphalt tile. However, where an underlayer is not used, asphalt-saturated felt should be laid before snapping the chalk lines across the room. Don't apply more than 6 or 8 sq. ft. of the adhesive at a time, and lay the tile immediately after applying the adhesive.

A good thing to remember when laying asphalt floor tiling is that it can be ironed into place. Set the iron for medium heat and proceed as in the illustration below. Not only does the weight of the iron help to make a better bond between the tile and the adhesive, but the heat from the iron softens the brittle tile and permits pressing down any curled edges.

To remove adhesive smudges from the face of asphalt tile, wipe the tile with a wet

cloth dipped in scouring powder and follow with a rinse of clear water. But don't use scouring powder or harsh soap to clean the tile after installation. Use only warm water and a mild soap, and polish with a good grade of self-polishing wax. Do not wash a rubber-tile floor until after the tile has been in place for two or three days. To keep the floor clean, wash with warm water and a detergent and rinse with clear water. Dry with a clean mop. Wax occasionally with a self-polishing floor wax. Take care of the cork floor in the same way as the rubber tile, and be sure to leave no puddles of water on the floor after washing. Certain types of paste wax may be used on cork tile, but never use paste wax or waxes containing mineral-spirit solvents on asphalt or rubber tile.

Dried paint and varnish can be removed from plastic tile with a solution consisting of pure gum turpentine, 1 part, and rubbing alcohol, 3 parts. Do not use turpentine substitutes in this formula, as they may damage the tile. The slight dulling of the tile resulting from this treatment can be eliminated by polishing the tile for a moment or two with a thick paste of powdered chalk and water and then wiping with a clean dry cloth. Plastic tile which has been damaged by solvents such as nail-polish remover and paint remover also can be restored to its original finish. In such cases, the damaged area is rubbed briskly with a paste of fine or medium pumice and water. When the marks are removed, the tile must be polished again with powdered-chalk paste. This same treatment works well where the tile has been scratched or scarred.

If white bathroom floor tile becomes discolored, it is doubtful if you can wholly restore the original color, especially if the surface is pretty well worn. A strong solution of trisodium phosphate will remove the embedded grime and dirt in both the tile and the joints, but it will do little to affect the discoloration. A medium solution of oxalic acid will be more likely to bleach out the discolorations so that they at least would be less noticeable. A mild solution should be used, as a strong solution may damage the tile, particularly on the worn spots. If the acid solution is used, apply it to the floor with a cloth swab and immediately wash or mop the floor with clear water to remove all traces of the acid. In a closed room, provide a fan to carry away fumes from the acid solution and do not place your hands in the solution or handle any cloth or swab soaked in it.

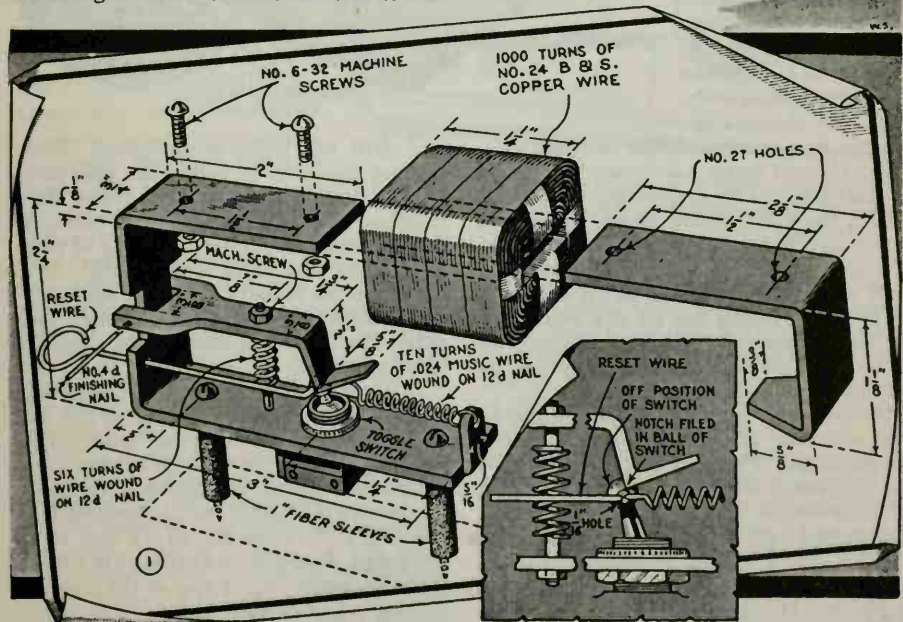
¶ To keep your bathroom tiles glistening, dip a soft cloth in kerosene and rub over them. Wash with warm water and dry.

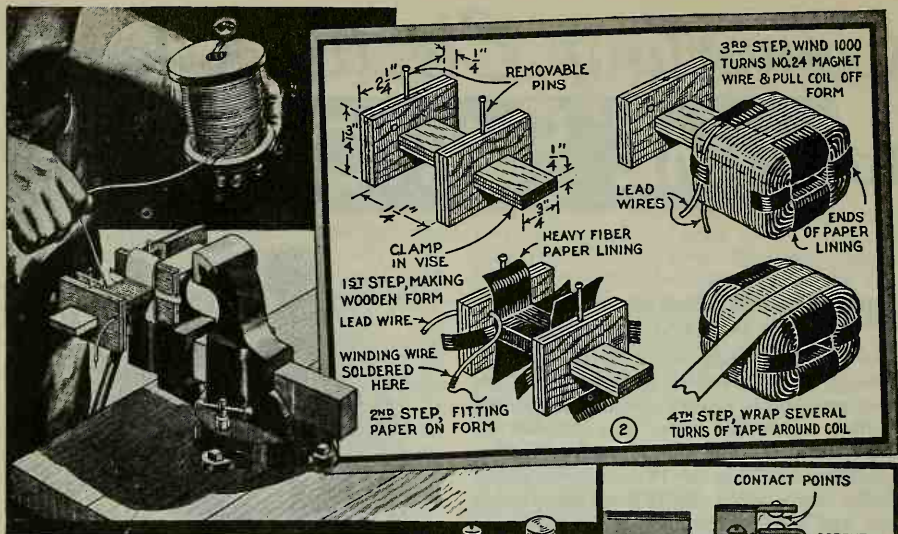


Converting Electric Clocks to TIME SWITCHES

DO YOU need a time switch to turn off lights or electrical appliances at a predetermined time when no one will be there to turn the switch by hand? Perhaps your problem is to turn one circuit off and another on at the same time, or after an elapse of time. By simply making a few alterations in one or two electric alarm clocks and making relays from some scrap iron and some copper wire, you can have these automatic servants to save your time and labor. In effect you are altering them to form time switches, which turn electric circuits on and off at any time for which the clocks are set.

Three models: Three models of time switches will cover many needs. The relays used are the same but the circuit connections vary, as shown in the diagrams Figs. 7, 8 and 9. The arrangement in Fig. 7 is a straight cut-off switch. Merchants will

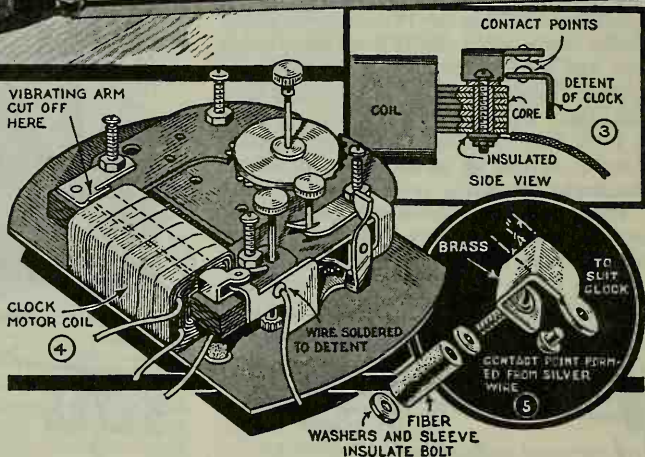




find it useful for shutting off display lights. Or, this arrangement is useful for turning off a radio, ventilating fan, outdoor lights and other appliances. A slight elaboration of the circuit, as shown in Fig. 8, enables one to turn one circuit off and another on at the same time, or either one of these functions separately.

With this switch a radio can be turned on in the morning, or a solenoid-type water valve can be opened to start a sprinkler system, etc. The third model has two electric alarm clocks and two relays, Fig. 9. This one will turn a circuit on and then off after a lapse of time, such as turning hall and porch lights on early in an evening and off at a later time. As all of these time switches are designed to be portable and compact, they can be moved around wherever needed.

Making the relay: Fig. 1 shows the general assembly of the relay, and the parts comprising it. Flat iron $\frac{1}{8}$ in. thick is used for the frame, pole piece and armature. It is advisable to anneal the bends from a cherry-red heat to relieve the strains set up in them. This can be done over a gas stove or even in the furnace of your heating plant. Dress up the pieces with a file



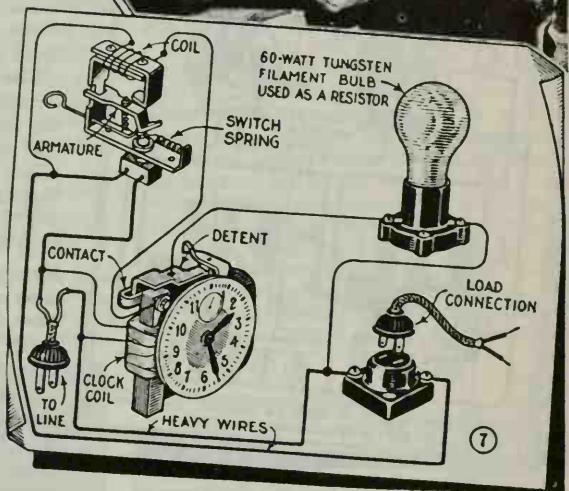
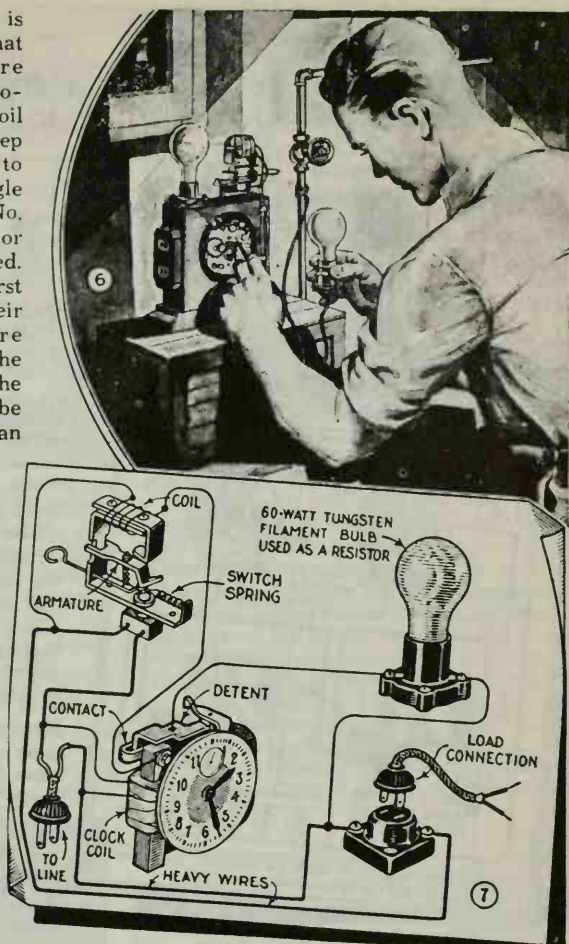
and drill the holes as indicated. When drilling the holes to fasten the pole piece to the frame, it is advisable to clamp them together and drill through both pieces at once to insure a perfect matching of these holes when the relay is assembled. Drill the hinge-pin holes in the frame and armature before notching them out to fit each other. Care must be used not to allow the holes to wander off center.

To wind the armature and switch springs, a small flat is filed on the side of the nail so that the end of the music wire can be clamped to it in the vise. Wind the turns as closely together as possible. No. 24-ga. music wire is used for making both springs. See Fig. 1. In notching up the ball tip of the toggle switch do not attempt to form it by hammering. Use a file, as the toggle is usually made of hard brass and is brittle.

The notch for the switch catch is filed on the side of the toggle that is held by the relay armature when the switch is in the on position. Details of winding the coil on a form are shown step by step in Fig. 2. It is not necessary to wind the coil in layers. Single cotton-covered magnet wire, No. 24, is satisfactory, but enameled or other insulated wire may be used.

In assembling the relay, first place the mounting screws in their holes, then hinge the armature and mount the toggle switch. The armature or switch catch and the toggle switch usually have to be adjusted to each other. This can be accomplished by carefully bending the catch with a pair of pliers if necessary, and also by moving the switch up and down by means of the mounting nuts. A piece of stiff wire will serve as the reset catch when bent to shape. Slip the coil on the frame, insert the pole piece, and fasten the two together. Tighten the fastening screws securely to prevent the pole piece from chattering.

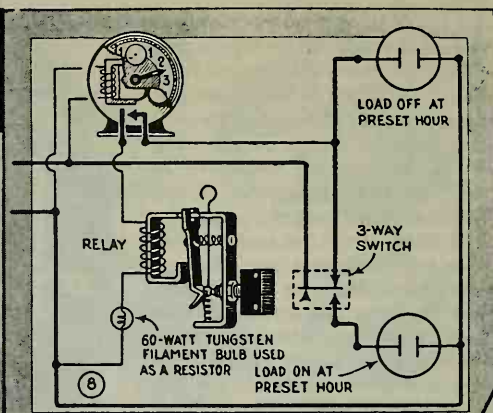
Modifying the clock: Alterations on the clock are the same for all the models and consist of installing a pair of electrical contacts in the alarm system. Where two clocks are used, the procedure is exactly the same for both clocks. The clocks do not need to be alike so long as they both have an alarm system. The alarm system of an electric clock is very simple. As shown in Fig. 4, a vibrator arm, which lies next to the motor coil, is riveted at one end to the laminated core of the clock and is held in place at the other end by a movable detent or catch, which releases the arm, allowing it to vibrate. The vibrating arm is cut off as indicated. A contact point on the detent is made by removing the detent, drilling a hole in it at the point shown, inserting a short piece of silver wire, (obtainable at jewelers) and riveting over the ends with a hammer. Use a hardwood block to back up the work while riveting the wire, to prevent excessive flattening of the contact on the other side. A second silver contact is mounted



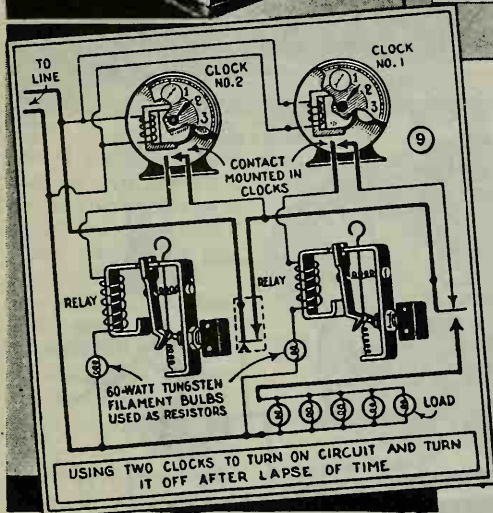
in the same way on a piece of sheet brass cut to fit your particular clock. This contact must be electrically insulated from the rest of the works when mounting it on the laminated core as shown in Figs. 3 and 5. Then the lead wires are soldered in place. Bring these wires through the cord hole in the back cover plate and close up the clock. Cut off the clock cord about 3 in. outside of the cord hole. If, by chance, you have clocks already equipped with contacts, these may be used and this part of the work omitted by simply bringing out leads from them after disconnecting them from the rest of the clock works.

Mounting the parts, wiring and testing:

If the clock has a wooden frame, the relay, the lamp receptacle and the load plug-in socket can be screwed to the top and sides.

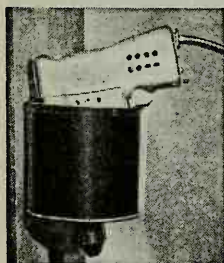


TO TURN OFF ONE CIRCUIT AND TURN ON ANOTHER AT THE SAME TIME



Otherwise these parts and the clock are all mounted on a wooden base of suitable size. In wiring, do not use a wire size of less than No. 14 gauge where the lines on the diagram are heavy, but No. 20 gauge wire is sufficient for the lighter wiring. In all

Tin Can Holds Electric Drill On Tool Panel or Wall



Wanting to get my small electric drill out of the way and protect it from possible damage, I hit upon the idea of placing it in a holder made from an empty tobacco can. After cutting the bottom from the can, I nailed the can to

cases, stranded wire is preferable to solid conductors.

Use a 60-watt lamp in the resistance receptacle, pull the reset back until the catch holds the switch, and plug the switch clock into the line. Do not touch anything until you have made a test to find the grounded side as in Fig. 6. This is done by touching one lead from a lamp to the metal back of the clock and the other lead to a water pipe or radiator valve to obtain a good electrical ground connection. If the lamp lights, reverse the cord plug used to connect the clock to an outlet. After this has been done, plug some convenient test load such as a desk lamp into the load receptacle. The lamp should now go off at any time to which the alarm is set. In Figs. 8 and 9, three-way switches are used. In the diagrams, connections are made to the switch as indicated in the dotted portion although the switch itself is shown attached to the relay without any connections.

the wall at a convenient height from the floor. In this way, the drill is always within easy reach when needed and is not exposed to rough handling when not being used. Disconnect the drill before placing it in the holder.

TIN CAN PROJECTS

CRAFTSMEN who like to work with metals but find that copper, aluminum and other favorite materials not only are expensive but difficult to get, can discover an unlimited source of metal by using the common tin can. The cost is nothing and the material, which actually is tin-plated steel, works into an unexpectedly handsome project. When the tin plate has been hammered and burnished with steel wool it takes on an attractive silvery gleam that remains bright indoors without lacquer or other protective coatings.

To store the tin plate for further use, remove the ends of the cans with a rotary-type opener. Then cut one side of the can parallel to the seam and as close to it as possible. Flatten the cylinder to form a rectangular sheet of metal which, from the largest household-size can in general use, will be about $7\frac{1}{2} \times 19$ in. However, should you decide on a project which requires a larger sheet of metal, you usually will be

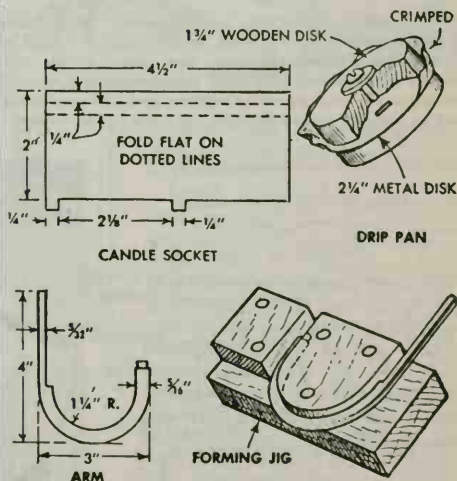
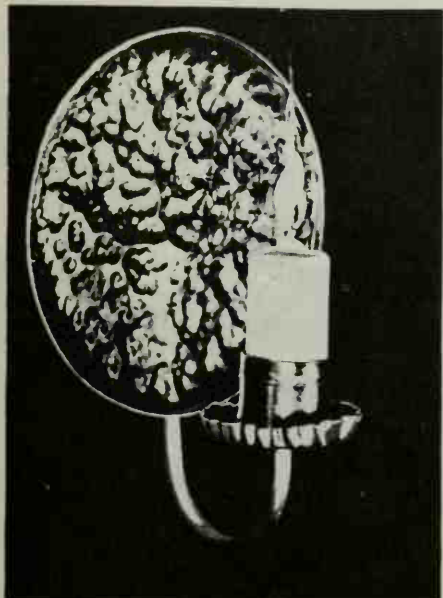
able to obtain cans of sufficient size from local restaurants or soda fountains.

When marking the metal for cutting, use a scribe or awl, but if it is difficult to see the scribed lines coat the work with India ink before scribing. The ink dries rapidly and is easy to wash off when finished.

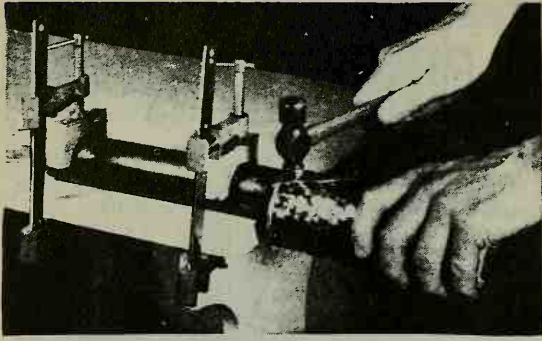
Cut straight lines and large-radius curves with tin snips, using a pair of old scissors to cut curves having a small radius. Use a jigsaw with a fine-toothed blade for inside cuts, and sandwich the work between two pieces of thin, soft wood for cutting. Lay out the pattern on the upper piece of wood.

You probably will want a hammered surface for most of the projects, and this is attained quickly by indenting the metal with a ball-peen hammer. The work is placed on a block of wood for hammering, the effect being varied by the softness or hardness of the block, the size of the hammer, force of the blows and thickness of the metal. With a little experimenting, just the right effect can be attained. You will notice that hammering the metal causes the sheet to buckle, or become dished. This can be corrected by placing the metal between two boards after hammering and

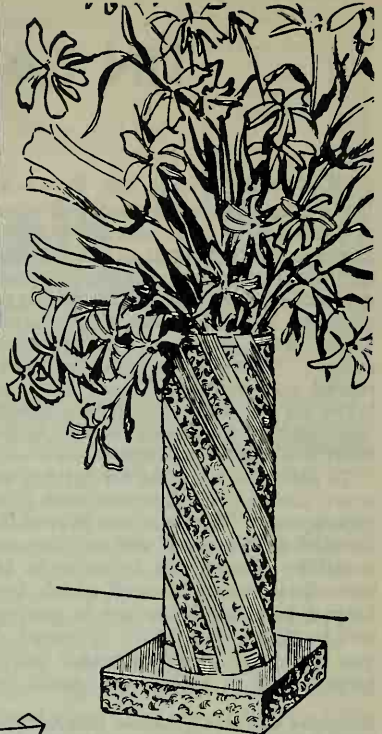
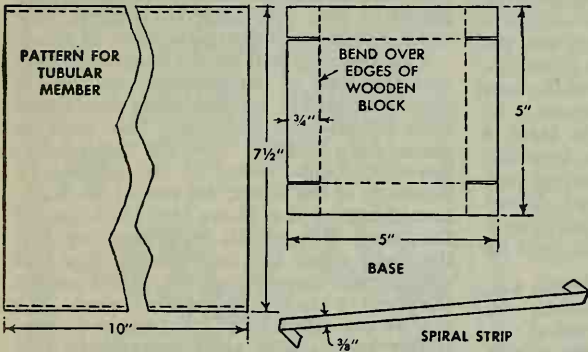
Decorative wall sconce features reflector made from coffee-can top. Tabs anchor socket to slatted drip pan which is riveted to tenon on front end of arm. Rear arm section is filed flat for riveting reflector



Wall Sconce

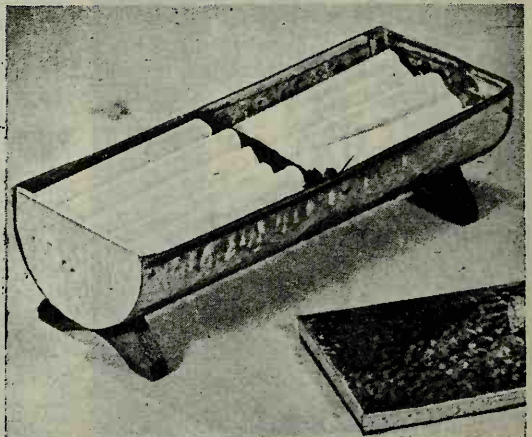
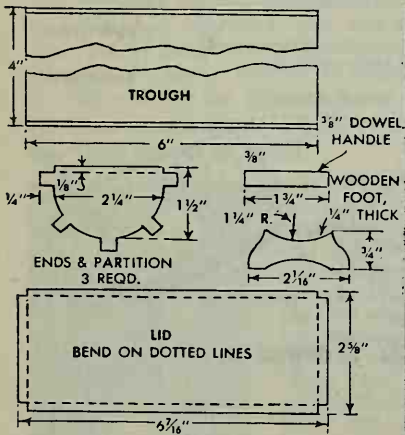


Attractive flower vase is made by bending hammered metal around pipe and riveting spiral overlays to cylinder. Angle irons riveted to sides of vase permit fastening to the base

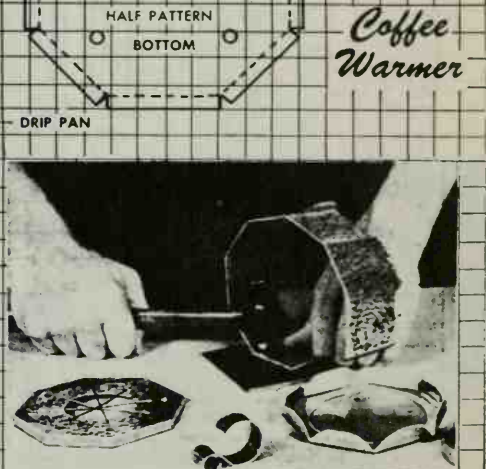
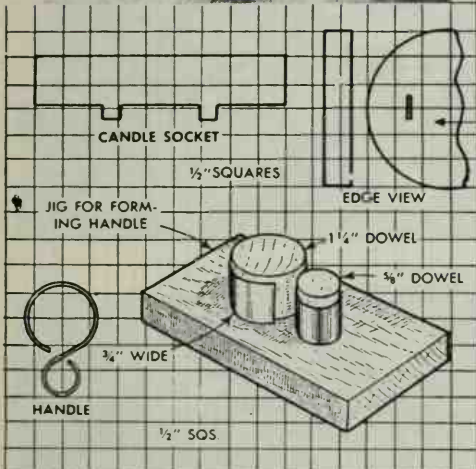
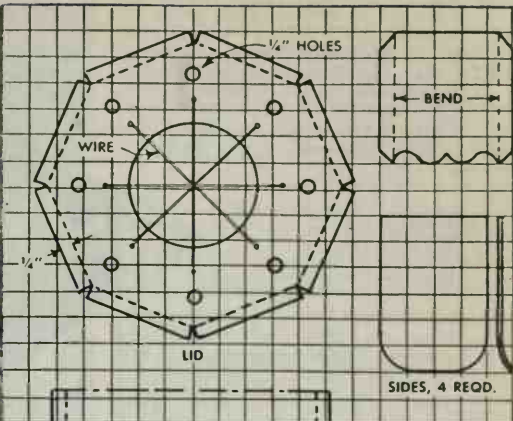


Flower Vase

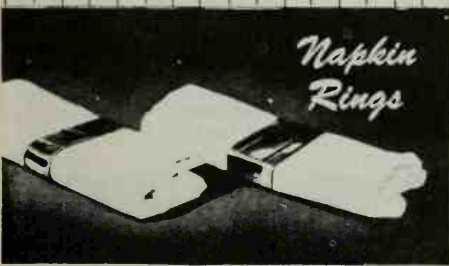
To make hammered cigarette trough, below, can is flattened, peened and then bent to form the trough at right angles to its original bend. In this way, the ends of the can provide ready-made beaded edges for the trough. Tabbed endpieces and center divider are riveted to the trough, while the wooden feet and lid handle are fastened with small round-headed screws. The trough is lined by cementing clear cellophane to the tin plate. An unusual coffee warmer and two neat napkin rings are detailed on the following page. Sides of the coffee warmer consist of eight separate pieces riveted together, four each of patterns shown in upper detail



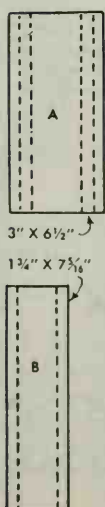
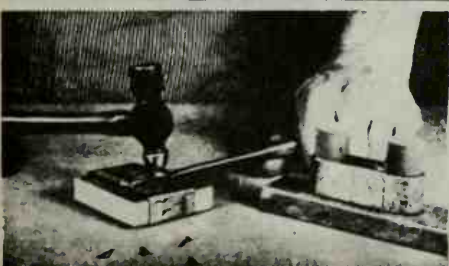
Cigarette Box



Coffee Warmer

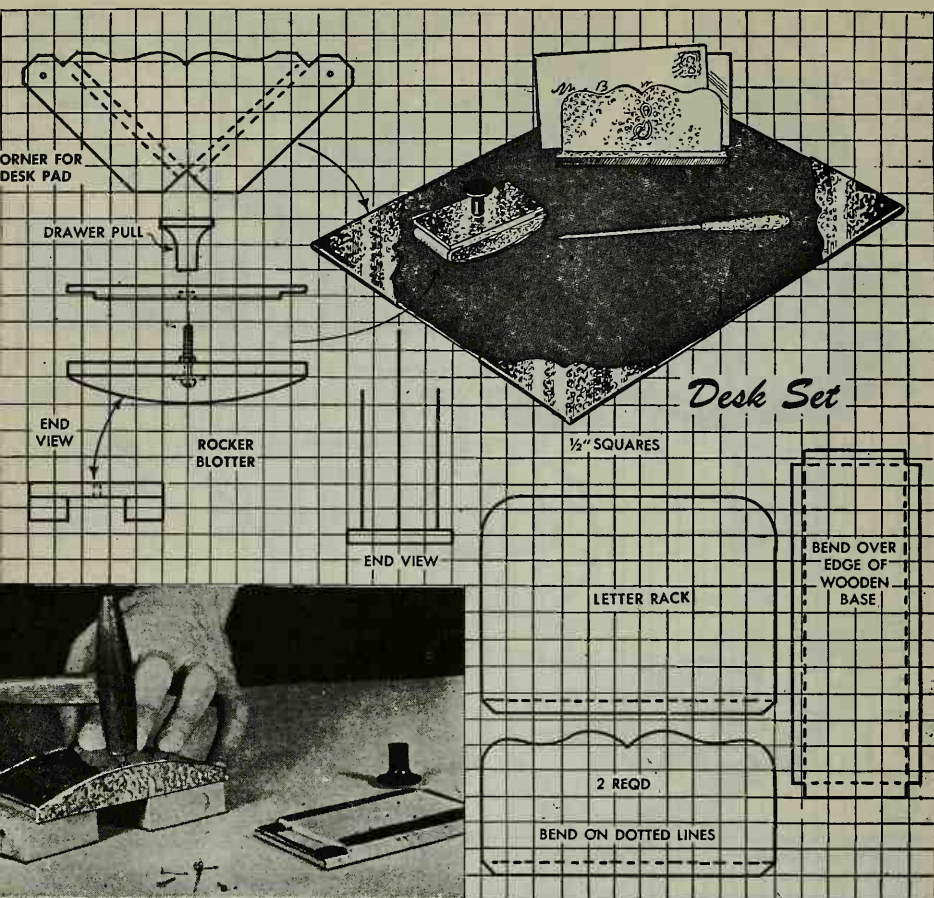


Napkin Rings



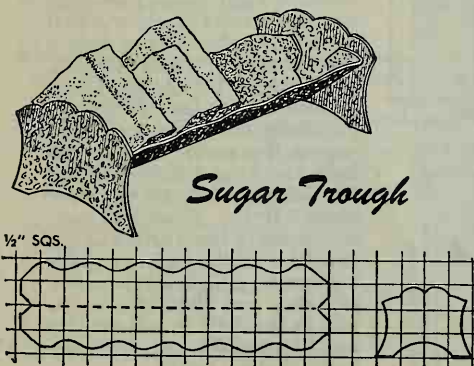
then striking the wooden surface with several sharp blows of a hammer.

Small nails (about the size used in cigar boxes) provide excellent rivets for sheet-metal work. Clip the nails so only a short length of shank remains, and back up the nailhead with an iron surface for riveting. As punching holes for the rivets upsets the metal around the holes, making a tight riveting job difficult, drill all the rivet holes. If the chuck of your drill press or hand drill will not take the small-diameter drills necessary, chuck the bit in a pin vise and then chuck the vise in the drill. A nail set also can be used for punching the holes in sheet metal.



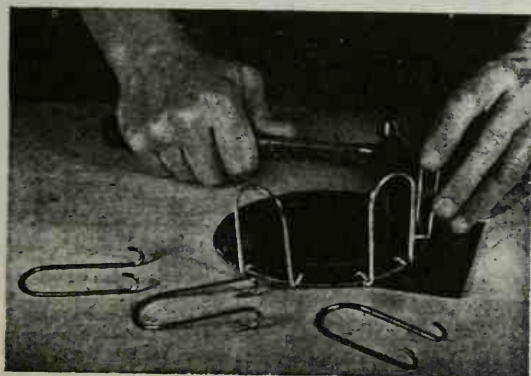
In matching desk set, above, tin plate corners are riveted to linoleum base to make desk pad. Rocker blotter is metal-covered wooden form. Uprights of letter rack are tacked to wooden base, and tin plate is riveted to the handle of purchased letter opener

The old-fashioned sugar trough, below, can be assembled with either metal or wooden ends. Note in the photo how a cardboard template is used when scribing the ink-coated metal. As ordinary ball-peen hammer makes too large an indentation for this work, peen by hammering with ball head of small hinge pin



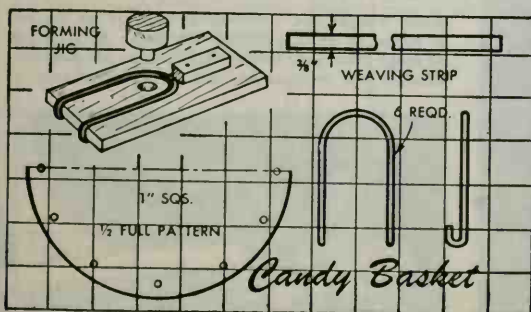


The candy basket pictured at the left is made by weaving strips of sheet metal cut from tin cans into a frame formed by a disk of sheet metal and wire half loops made in jig. Use a simple in-and-out basket weave, beginning at the bottom and working up to top of half loops. The handle consists of a sheet-metal strip with its edges folded

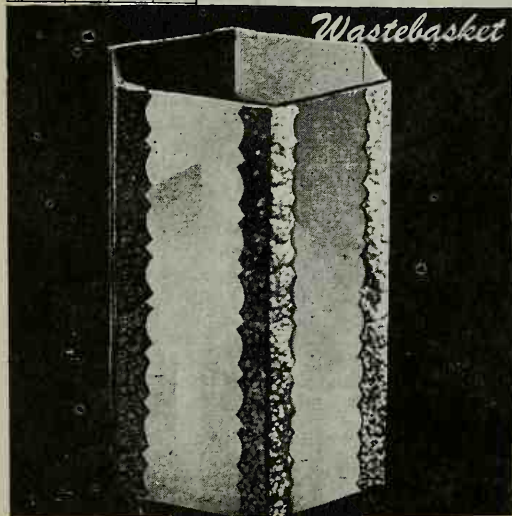
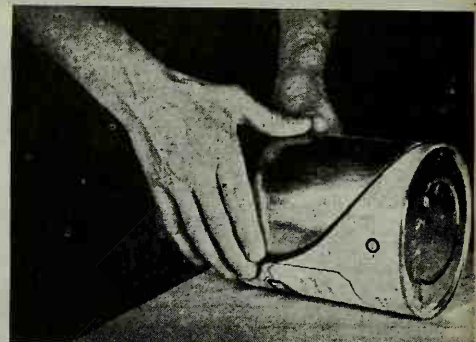
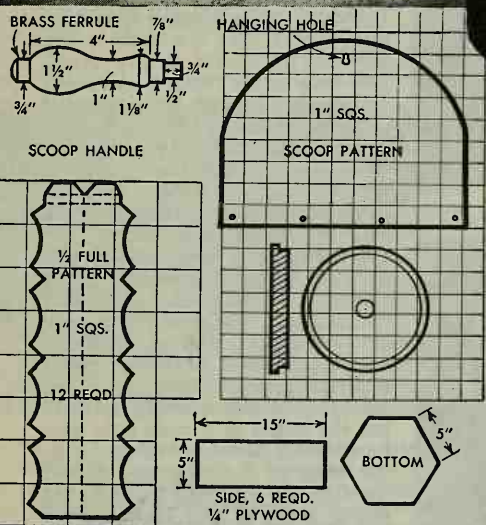
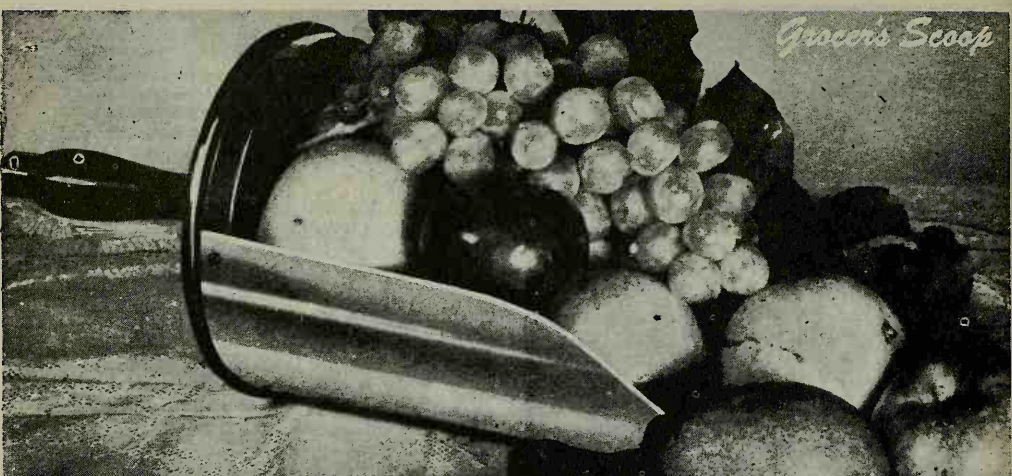


Using the same simple procedures previously described, it is possible to utilize strips and sheets cut from tin cans to make the attractive candy basket shown in the photo at the left, and the grocer's scoop and wastebasket pictured on the opposite page. The friction lid from a large can is used to form the bottom of the candy basket. Equally spaced holes are drilled or punched near the edge of the lid as in the detail below. Then six U-shaped units formed from medium-heavy wire are made on the forming jig shown in the detail. The ends of the formed half loops are passed through the holes and clinched as in the lower left-hand photo. This assembly serves as the spider on which the basket is woven with narrow strips cut from large tin cans. Cut the strips to a uniform width and smooth the edges with fine emery cloth. Use a simple in-and-out basket weave as shown in the photo. Note that the original basket is made with six strips, but if desired, the strips can be cut to a narrower width and ten or twelve used instead of six. The handle is made by folding the edges of a wide strip and hammering flat. After hammering, the ends of the strip are passed through the wire half loops on opposite sides of the basket, then bent back and riveted. Spraying the entire basket with a coat of clear metal lacquer will prevent discoloration due to rust.

The grocer's scoop requires a fairly large piece of metal and two hardwood turnings made according to the details on the opposite page. Note that the hardwood disk which provides the back, or bottom, of the scoop, is turned with a shallow rabbet and is center-drilled for the $\frac{1}{2}$ -in. tenon turned on the handle. The square flange left after rabbeting the disk is rounded slightly to form a bead. The brass ferrule at the outer end of the handle is optional. Finish the disk and handle in whatever

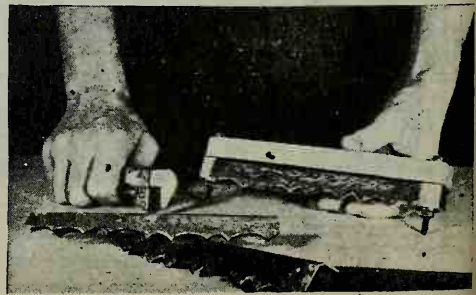


Grocer's Scoop



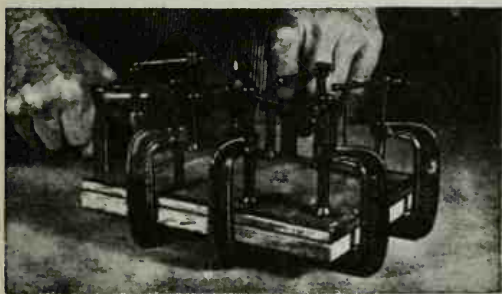
The grocer's scoop is made from a single piece of sheet metal cut from a large can. The metal is attached to a rabbeted disk turned from hardwood and fitted with a handle. Finish hardwood in color desired

Metal trim on the wastebasket pictured at the left is made of strips cut from tin cans. After edges of strips have been scalloped, the strips are hammer-finished and then coated with a clear metal lacquer

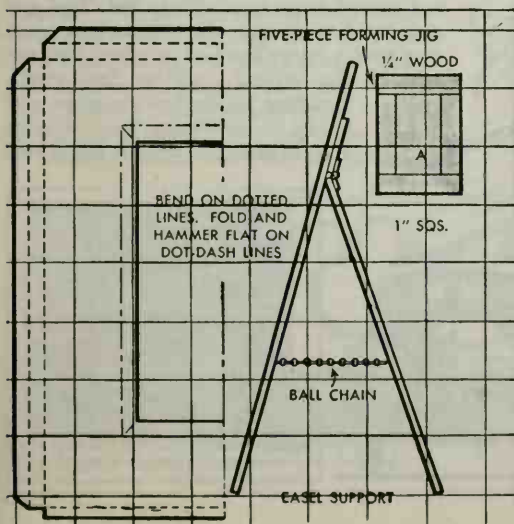




Hammer-finishing metal in this picture frame makes it unusually novel and attractive. Fitted with an easel-type leg, it stands firmly on mantel or table



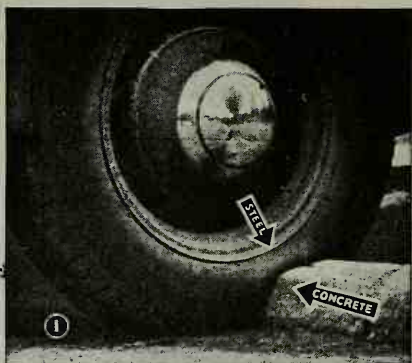
Metal frame is formed in a special five-piece jig which can be removed after frame is bent to shape



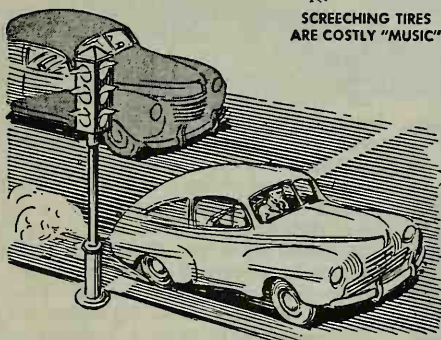
color is desired. Then cut the metal from a large can as in the center photo on the preceding page, punch or drill as indicated and attach to the rabbeted disk with four round-headed brass screws. Smooth the edges of the sheet metal with fine emery cloth. Finish with a coat of metal lacquer, applied as evenly as possible.

The hexagon wastebasket detailed and pictured on the preceding page is constructed of plywood and trimmed with scalloped strips of sheet metal cut from large tin cans. The lower right-hand photo (preceding page) shows a simple two-piece jig which is used in bending the strips to fit the basket. This is done after cutting the scalloped design on the edges and hammer-finishing the surface as described previously. Make the basket of $\frac{1}{4}$ -in. plywood, cutting six sides and the bottom as detailed. Assemble and finish in the color desired before applying the ornamental strips of tin with short brads or tacks. It's a good idea to coat the metal strips on both sides with clear metal lacquer before the application of the metal strips.

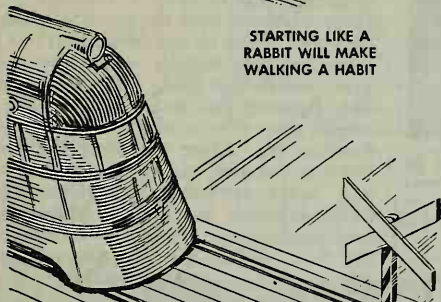
The novel photo frame pictured and detailed at the left is formed in a jig as in the center photo. First, make the forming jig, detail A, in five separate pieces so that it can be removed from the metal frame after the forming operation. The thickness of the wood in the jig makes the frame deep enough to take a backing piece of $\frac{1}{8}$ -in. plywood plus the picture, glass and a thin mat. Note in the detail that the dotted lines indicate bends, while the dot-dash lines indicate a fold, which is hammered flat. Be sure that the metal sheet is cut to ample size, then make a trial fit over the forming jig. After trimming the metal to the correct size, clamp in place in the jig and bend as indicated. After forming, hammer-finish the metal. Although some craftsmen may prefer to hammer-finish the metal before forming, there is the possibility that the dimples in the surface may be flattened somewhat by clamping in the forming jig. After forming, remove the jig and coat the metal with clear lacquer. Then cement the picture to a mat and cut glass and a backing piece to fit. Assemble these parts in order and slide into place in the frame. If desired, the frame may be fitted with a hinged, easel-type support. To do this, merely glue a small block of $\frac{1}{4}$ -in. hardwood to the center of the backing piece about $1\frac{1}{2}$ in. from the top and hinge a narrow strip to this to form the leg. Attach a short length of light ball chain to the leg and the backing to hold the leg in position when it is swung back to support the frame. A color photograph as well as a black-and-white print will show to good advantage in this frame.



**SCREECHING TIRES
ARE COSTLY "MUSIC"**



STARTING LIKE A RABBIT WILL MAKE WALKING A HABIT



**USE YOUR
EYES INSTEAD
OF YOUR FOOT**



PIGEON-TOED WHEELS GRIND OFF RUBBER

MOST of us can prolong the life of our tires as much as 50 percent simply by being careful in our driving habits and by giving the tires the attention they should have. Yielding to the temptation of driving fast to reach a destination in a period of time that requires the speed of a streamliner literally tears mileage off your tires. Actually, tires wear 60 percent faster at 70 m.p.h. than they do at 50 m.p.h. because brakes must be applied more severely, slippage between tires and road is increased, and heat generated at high speeds softens the rubber and tends to separate the cords from it. Fig. 2 shows the percentage of tire wear at different speeds.

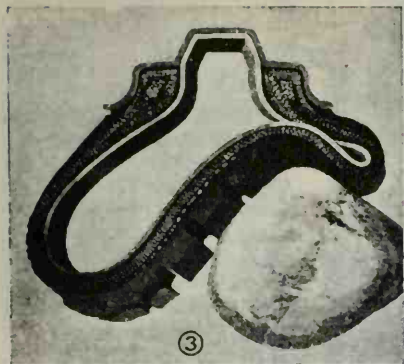
You wouldn't deliberately run a grinding wheel over your tires, but they are subjected to similar abrasive action when you take a curve too fast or when the rear wheels slip when making fast starts.

Coasting up to known stops and trying to anticipate the unknown ones in plenty of time to avoid set-

40 M.P.H. 50 M.P.H. 60 M.P.H.

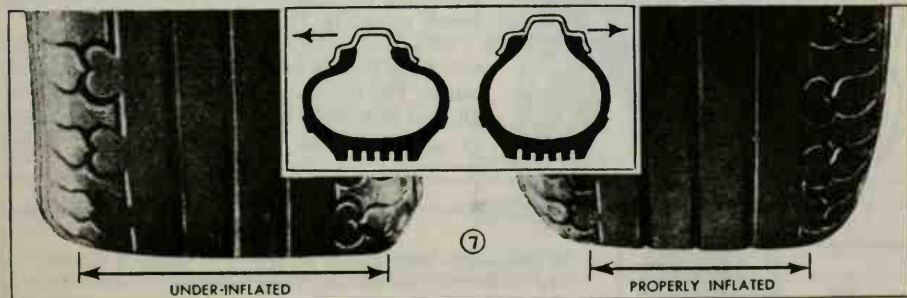
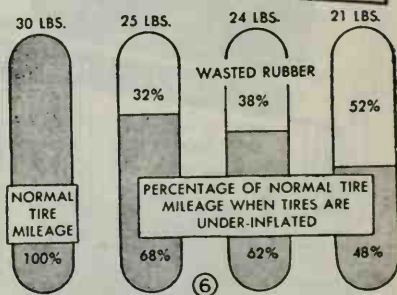
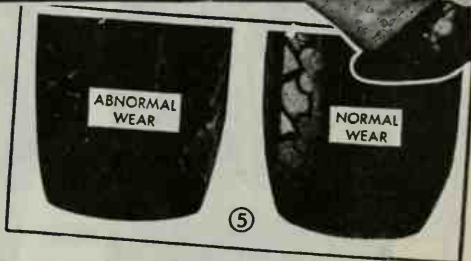
78% 60% 45%

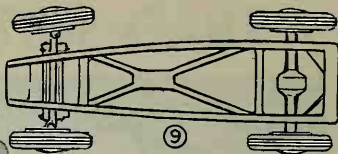
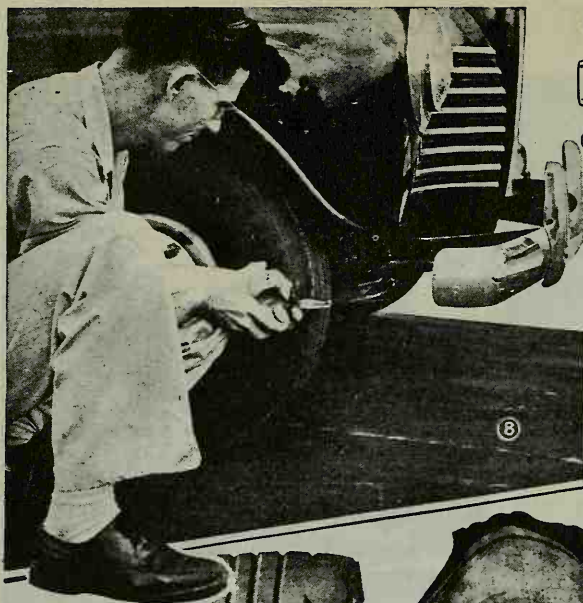
PERCENTAGE OF NORMAL TIRE MILEAGE AS DRIVING SPEEDS INCREASE (2)



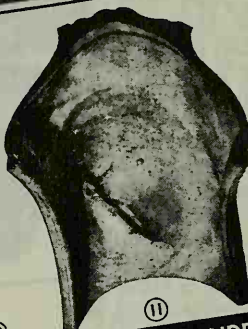
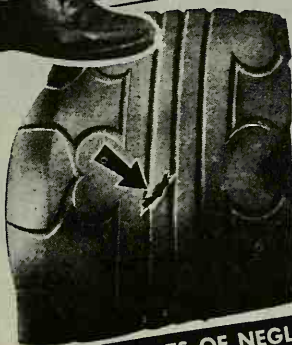
ting the brakes hard will add many miles to your tires. Also, avoid holes in the pavement and small objects lying on it, and be careful when you park to avoid hitting a curb, Fig. 1. Striking such obstacles pinches a tire, creasing it sharply and pressing it against the steel rim of the wheel, which is likely to break the fabric and cords, Fig. 3.

Probably the greatest enemy of long tire life is incorrect inflation, which can be avoided by making weekly or semi-weekly checks. Both the air and service for this are free and it takes only a few minutes of your time. Keep the pressure in your tires as recommended by the tire manufacturer. If you put in a pound or so too much, let it out, Fig. 4, because overinflation is just as bad as underinflation. While it's true that underinflated tires give a soft ride, they are very expensive cushions as the tread wears rapidly and the cords inside the tire tend to separate from the rubber as in Fig. 12. A glance at Figs. 5, 6 and 7 will show more results of underinflation. One tire manufacturer

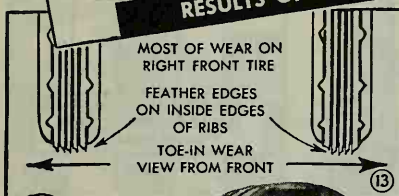




claims that under average driving conditions a popular-size tire loses 2 lbs. of air a week. Such a tire, under-inflated 6 lbs., loses as much as 25 percent of its normal mileage. Aside from increased mileage resulting from regular attention to the tires, there is another ad-

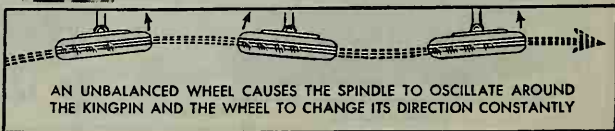
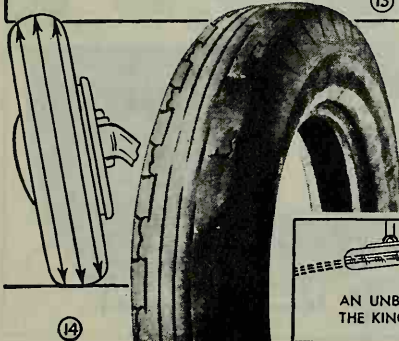


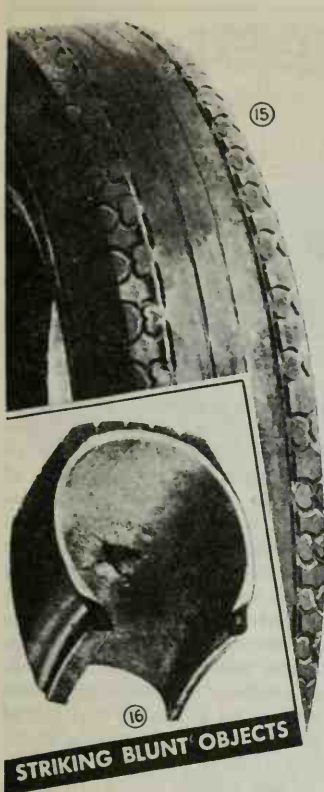
RESULTS OF NEGLECTED TREAD CUTS, UNDER-INFLATION AND



vantage in the fact that a slow leak can be detected when checking air pressure. With a 2-lb. pressure loss per week, a tire that has lost 6 to 8 lbs. is sure to have a leak. If a piece of glass or a nail is found and removed, Fig. 8, the cut should be cleaned and sealed with rubber putty or cement to prevent moisture from working into the cords. Cords act like wicks and hold moisture, causing them to rot and eventually break as in Fig. 11.

Blow-outs don't just happen, but the contributing causes often occur sometime previously. The cause may be a small tread cut, Fig. 10, that was neglected or was enlarged by over- or underinflation. Contacting a sharp object

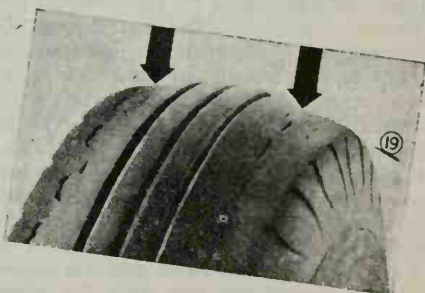
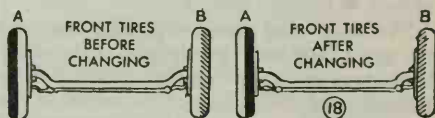




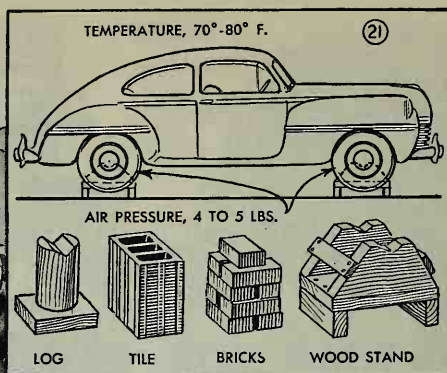
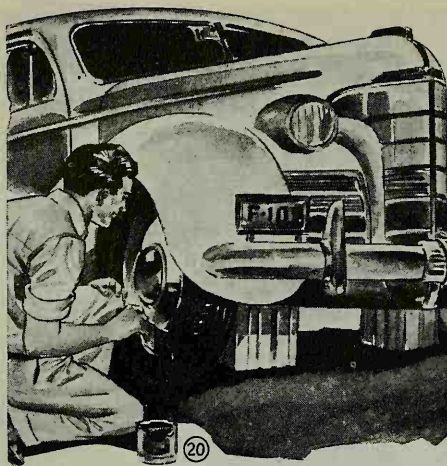
on the road does not always result in immediately visible damage but may break the cords as seen in Fig. 16, and this in turn may lead to a blowout. When your car is on a hoist being lubricated, it is a good idea to run the fingers over the tires. If the tire has been damaged in this way, there may be a slight bulge which may not be enough to see, but can be felt.

Misaligned wheels or improperly adjusted brakes take a high toll in tire life. A wheel that is $\frac{1}{2}$ in. out of alignment, drags sideways 87 ft. per mile. Fig. 15 shows what happens to the tire tread when this condition exists. Where front wheels do not track true, Fig. 9, one of them does the steering and the other one drags, which scuffs away the tread just like rubbing the tire with a file. If the edges on one side of the tread design are sharp or feathered, Fig. 13, when rubbing the hand across the tread, this condition indicates that the wheels are not in perfect alignment.

Does your car pull to one side when the brakes are applied? If so, you may be sure



that brake adjustment is unequal, that most of the braking action is on one tire. On a test made by one manufacturer, the brakes were adjusted so that one wheel only would lock. At a speed of 80 m.p.h. the brakes were applied and held until the car stopped. When the tires were exam-



ined, the tread of the tire on the locked wheel was worn down to the breaker strip by this single operation alone. Even stepping hard on the brakes at 35 m.p.h. will scuff off enough tread to carry a car a full road mile.

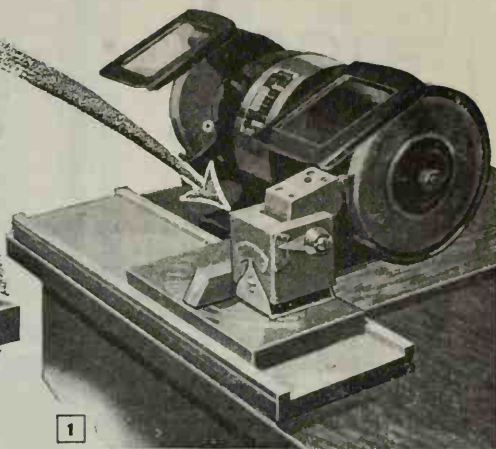
"Heel and toe" wear may occur on any type of tread design, and to some extent is normal, though high-speed driving and excessive use of the brakes will accelerate the rate of wear. The remedy for this condition is to change the position of the tires on the car. Two ways of doing this are shown in Figs. 17 and 18.

The subject of wheel alignment includes far more than mere toe-in, one of the other important factors being that of camber, or the outward inclination of the wheel at the top. This is necessary for easy steering and maximum strength of the front system, but if present in excessive or unequal amounts, it creates tire trouble. In effect, due to the roundness of the tread, camber gives a tire several diameters, as indicated by the three arrows in Fig. 14. As the tire revolves as a unit, something must slip, and where the camber is excessive there will be tread wear. To minimize this, tires should be changed about as indicated by A and B in Fig. 18. To do this it is necessary to remove the tire from the wheel and turn it around. Rounding turns at excessive speed, especially with tires that are soft, creates a screeching sound. It is expensive "music," resulting in tread wear as indicated by the heavy arrows in Fig. 19. This can be offset to some extent, by changing the tires about as indicated in Fig. 17.

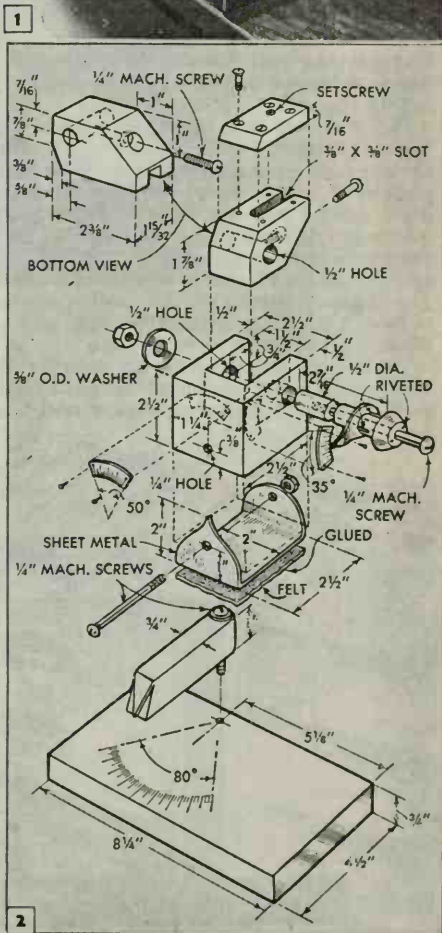
An unbalanced wheel may develop a spotty or cupped tread condition such as that shown in the photo of Fig. 14. Consequently, balancing of wheels should be considered as a regular maintenance item, for an unbalanced wheel, besides increasing tire wear, also causes considerable wear in the steering spindles, spring shackles and other chassis parts, thus contributing to a looseness which is conducive to further troubles. The disturbing forces produced by an unbalanced wheel increase tremendously with increase of speed. An assembly 1 oz. out of balance at the tread, will develop a 12-lb. vibrating force at 60 m.p.h. And, it is not uncommon to find wheels that are 6 or 12 oz. out of balance. While it is most important to keep the front wheels balanced, it is highly desirable to balance all wheels if the smoothest, most economical car operation is to be had. Alignment of wheels also should include an inspection of the rims, for a rim that is badly bent or rusted will injure the tube as well as the tire.

Removing Tires From Safety Rims

It is not such a difficult job to remove a tire from a safety rim if you go at it in the right way. Just stand with the heels on the tire at about the edge of the tread or white side walls and roll the bead out of the safety groove. This cannot be done when the heel is placed too close to the edge of the wheel. By using this method of breaking the bead from the safety groove, you can remove the tire in just a few minutes.



EVERY experienced machinist knows just how near to the impossible it is to grind the three angles on a lathe or shaper tool bit correctly by hand. Perhaps one, or maybe two, can be done freehand with fair accuracy, but three angles—that's too big an order in most good shops. A better answer way is to make a grinding jig such as that detailed in Fig. 2. This jig gives the necessary movement in three planes, one each for the cutting angle, the side clearance angle and the front clearance angle successively. Calibrations indicate the various angle settings accurately. Although it's not to be classed as a precision tool this jig will be found practical for grinding lathe and shaper bits for ordinary work. To make the three principal parts of the jig use a material that mills well. The base, Fig. 2, slides in a guide as in Fig. 1. The swiveling member, which supports the toolholder, is calibrated through a 50-deg. included angle for grinding side clearance. The base calibration of 80 deg. provides for grinding the cutting angle, while the 35-deg. calibration of the toolholder takes care of the front clearance angle. However, calibration for the latter is correct only when grinding on the side of the wheel. When grinding on the face of the wheel the jig must be lowered so that the tool bit contacts the wheel at a point exactly in line laterally with its axis. Otherwise the correct grinding angle must be calculated. This can be done by sketching an enlarged section of the wheel and toolholder and then plotting the required angle setting.

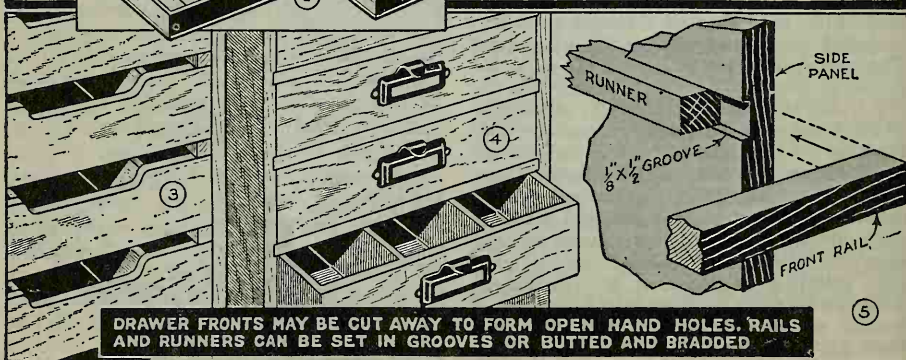
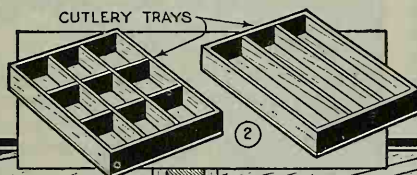
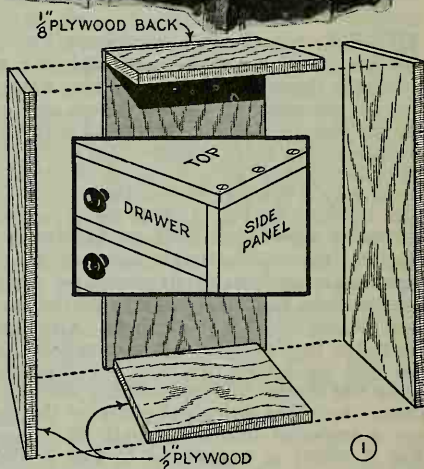


TOOL CABINETS

HERE'S a way you can make a neat tool and small-parts cabinet without a lot of tedious drawer making. You simply purchase some of the type of wooden cutlery trays that are sold in five and ten-cent stores. They are already divided into compartments and will be found ideal for keeping small tools, nails, screws, etc. If you desire, the trays can be divided into still smaller compartments as shown in the left-hand detail of Fig. 2.

Fig. 1 shows the construction details of the tool cabinet. Since the size of the cabinet depends on the dimensions of the trays purchased, exact specifications for the finished cabinet are not given. The work involves simply enclosing the purchased trays in a frame of $\frac{1}{2}$ -in. plywood grooved at proper intervals to take drawer runners, Fig. 5. The top and bottom of the cabinet are attached to the sides with flat-headed screws, while the back can be nailed on.

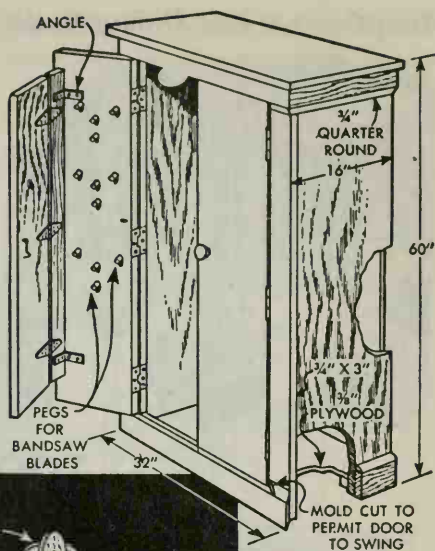
There are various ways to provide the trays with hand openings or pulls. Two methods are suggested in Figs. 3 and 4.



DRAWER FRONTS MAY BE CUT AWAY TO FORM OPEN HAND HOLES, RAILS AND RUNNERS CAN BE SET IN GROOVES OR BUTTED AND BRADDED

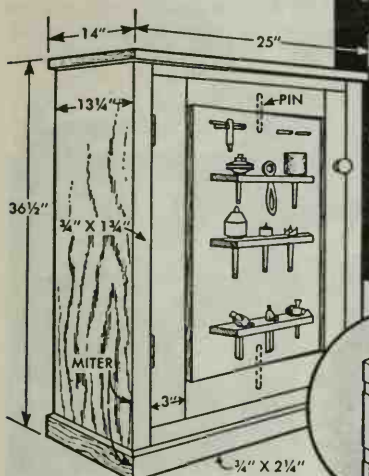
TOOL CABINETS

THE ONLY way to keep things in order in a shop of any size is to provide a convenient, handy place to keep all the power-tool accessories. Tool cabinets make it easy to do this with a minimum waste of time. All the cabinets detailed on this page are home built; you can't buy them ready-made. For this reason you'll have to draw heavily on your own labor and ingenuity in furnishing your shop. With tool cabinets providing ample storage facilities, it's easy to clear the bench tops for assembling and clamping wide stock and for trial setups of small units before gluing. As soon as you get your power tools, you can do a good job on tool cabinets and you'll have just as much enjoyment making them as you will with later projects.

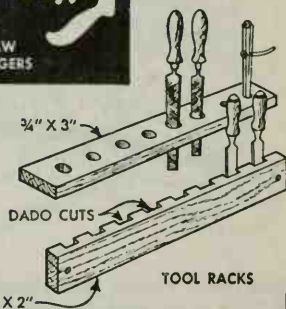
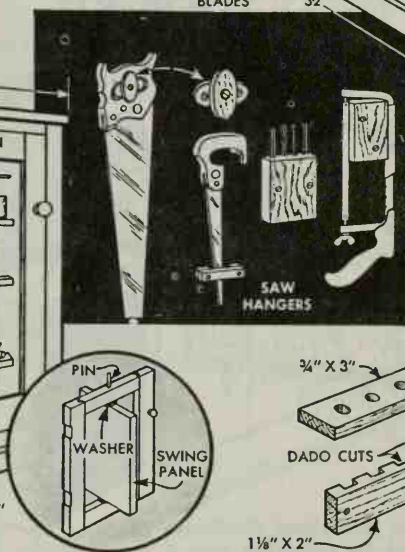


WALL CABINET

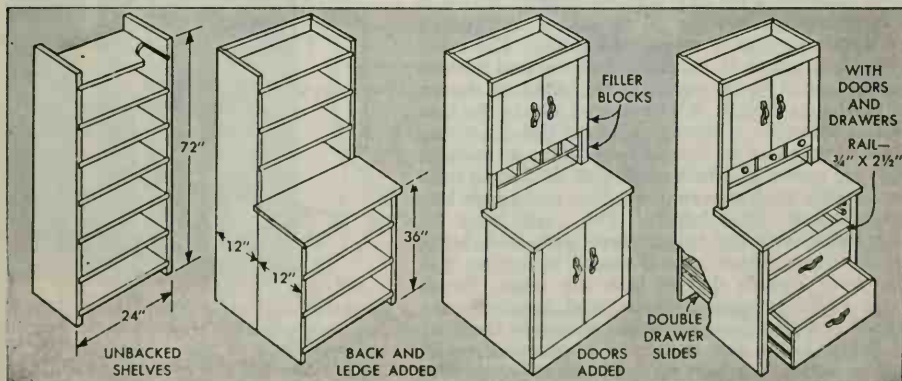
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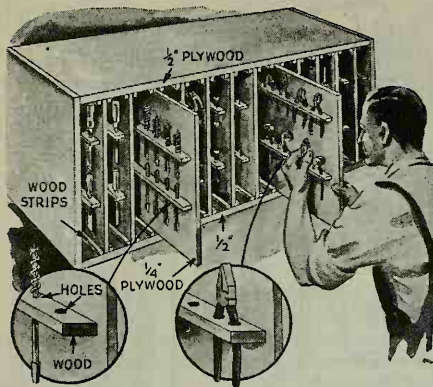
CABINET FOR LATHE TOOLS



11



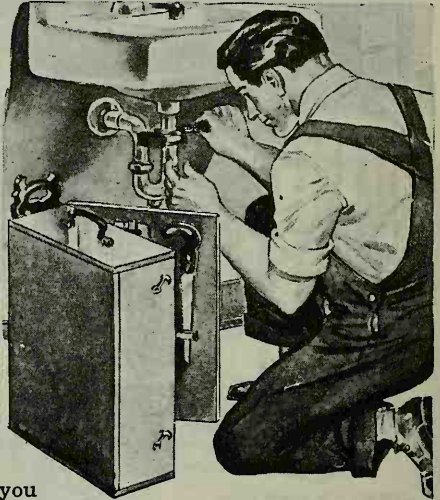
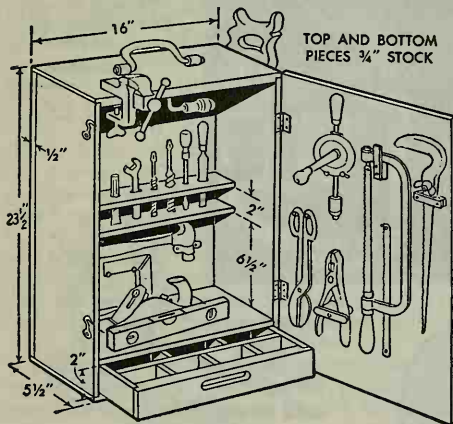
Tool Cabinet Has Sliding Racks and Occupies Small Space



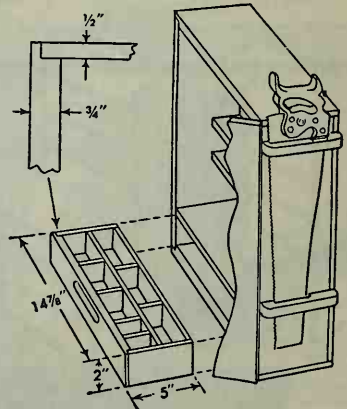
In shops where only a small amount of space is available, this handy cabinet will be just the thing for storing tools within easy reach of the bench. While almost any wood can be used to make the ends, top and bottom of the cabinet, plywood or hard-pressed board is recommended for the tool racks, which are cut slightly undersize and slide between small cleats screwed or nailed in place.

As each rack is fitted with holders to accommodate specific tools, it's a simple matter to locate any tool desired when needed. Since the lower edge of the tool panel carries all of the weight, it should be smoothly sanded and then waxed to give an easy sliding fit. Tools can be mounted on both sides of each panel.

TOOL KIT



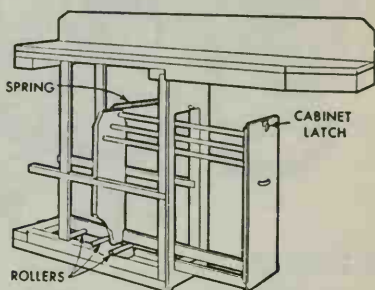
When doing repair jobs about the house you won't have to go back for forgotten tools if you keep them in a kit like the one shown, which is roomy enough to hold all necessary equipment yet small enough to be carried easily. The sides of the box are of $\frac{1}{2}$ -in. stock, but top and bottom pieces are of $\frac{3}{4}$ -in. material rabbeted as shown in the lower detail. A vise stored inside the box can be attached to the top when in use if a metal plate is screwed to the under surface to contact the vise screw. A two-tiered shelf drilled to take small tools such as wrenches, files and auger bits keeps these items handy. The shelf must be narrow enough not to interfere with tools hung on the door, which is held closed by hooks that slip over screws driven into the edge. Small parts such as nails, screws and washers are stored in a partitioned drawer, shown in the lower detail, and a saw is carried in cleats screwed to the outside surface of the box. After adding a handle the kit is painted or otherwise finished.



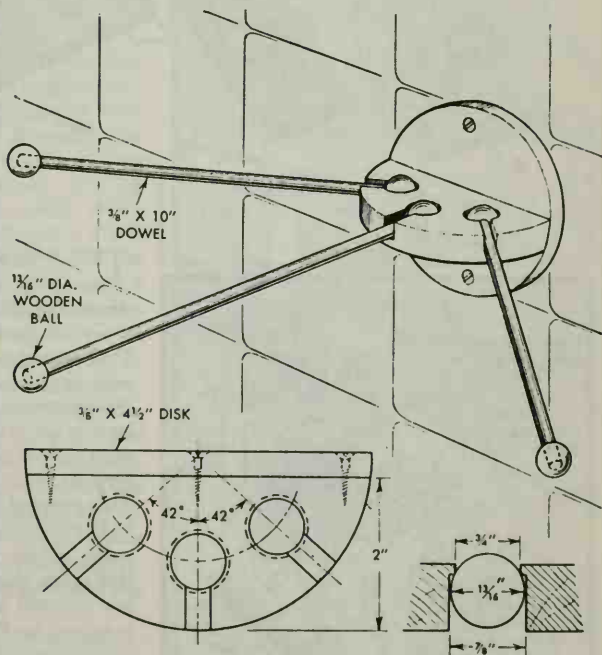
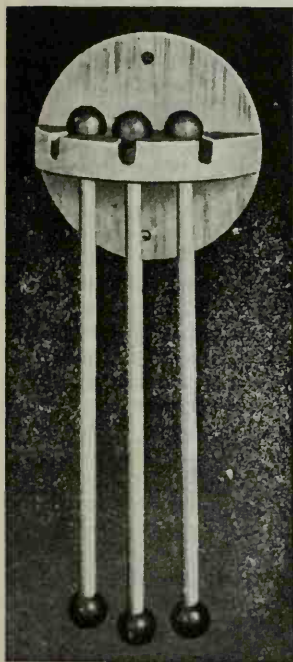
Combination Drier and Utility Shelf Installed in Waste Corner Space

Damp dishcloths and towels or an occasional piece of clothing can be dried out of sight, and the kitchen kept neat as a pin, if this combination drying rack and utility shelf is installed in space that otherwise would be wasted. Although the original unit was made to fit between a kitchen range and an adjacent wall, a similar rack can be fitted between cabinets or in any unoccupied corner. The drying rack consists of two plywood panels separated by lengths of dowel and bottom braces. Note that a window-shade spring is fastened to the back of the rack and the front panel covering the framework. This causes the rack, which is held closed with a cabinet-door catch, to spring open as soon as the catch is released. For smooth operation, the

rack rides on dowel rollers. These revolve on pins made by driving nails into the ends of the dowels and filing off the heads. The plywood utility shelf can be covered with linoleum or hardboard. However, if you wish to set hot pots and pans on the shelf, cover it with sheet aluminum. If the installation is made next to an uninsulated range, be sure to mount a piece of asbestos between the drier and the range.

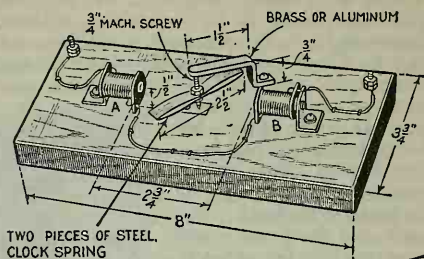
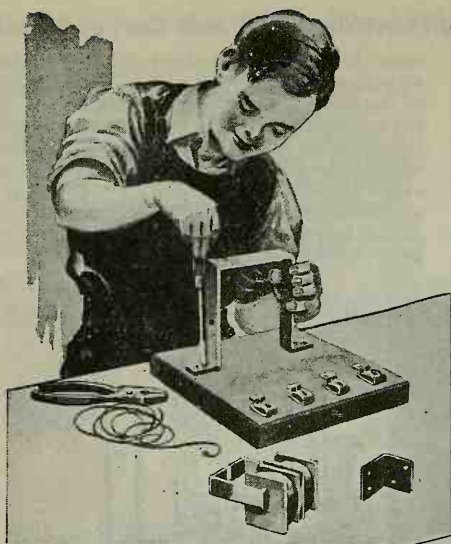


TOWEL RACK



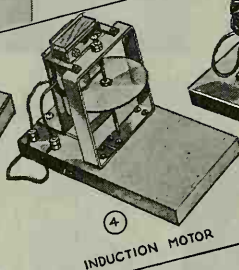
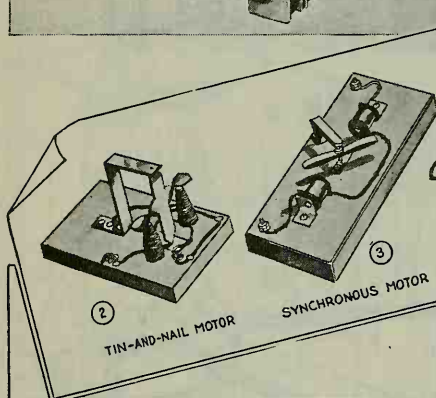
If you want something different in a towel rack, here's an exceptionally neat one that retracts against the wall. Lengths of birch dowel form the arms and balls turned from walnut are glued over the ends. Holes in the wall bracket must be counterbored carefully, as the counterbores serve as stops for the ball ends of the arms. To fold the rack, simply lift each arm and release it. The arm then falls to the vertical position as in the photo. Reverse the movement to bring the arms to the horizontal, or open, position

5 TOY

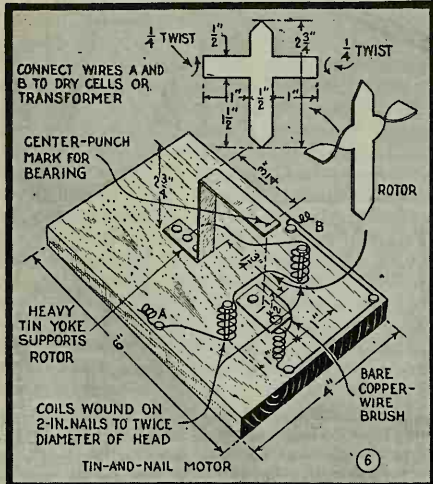


TWO PIECES OF STEEL, CLOCK SPRING
① MAGNETS A & B FROM BUZZER CONNECTED IN SERIES
SYNCHRONOUS MOTOR

SERIES MOTOR



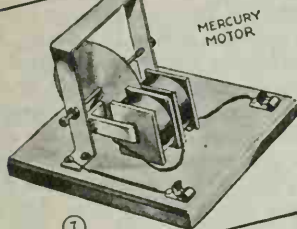
⑤



TIN-AND-NAIL MOTOR: One of the simplest forms of an electric motor where small electromagnets cause a tin rotor to spin, is shown in Figs. 2 and 6. This motor runs on a couple of dry cells or will operate on 6 volts a.c. provided by a transformer. The rotor acts like a tiny switch as it wipes against a brush lightly, turning on current momentarily just before its arms pass over the electromagnets. This current impulse, which occurs at each half rotation, is just enough to keep the rotor going. The rotor is cut from tin to the cross shape shown and the side arms are twisted at right angles. The electromagnets or field coils are wound in series on two nails, both windings being in the same direction. The nails are 2 in. apart. One end of the wire is scraped bare and twisted to form a tight coil which serves as a binding post, it being tacked down to

convey basic ideas

These simple electric motors, which run on low-voltage a.c. or d.c. as specified, are constructed from nails, wire and scraps of iron and tin. All of them have been built and made to operate; one provides ample power to drive small toys

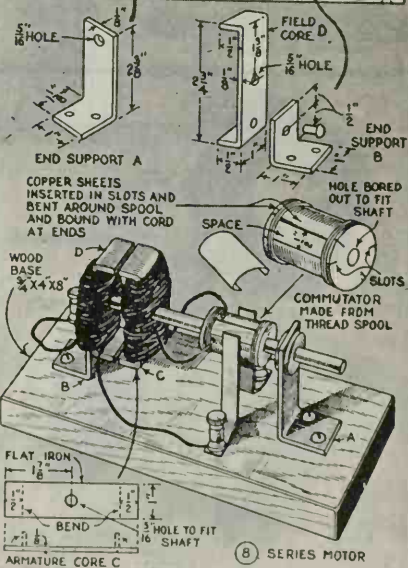
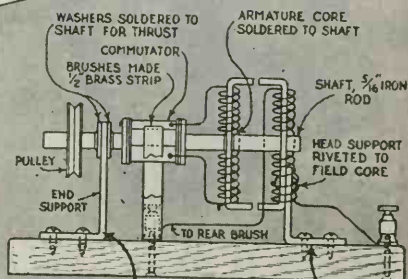


MERCURY
MOTOR

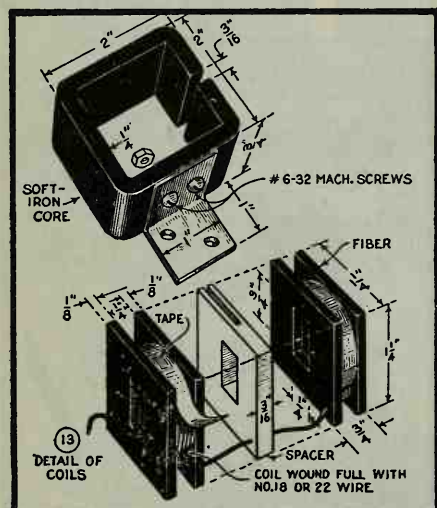
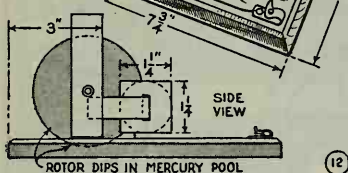
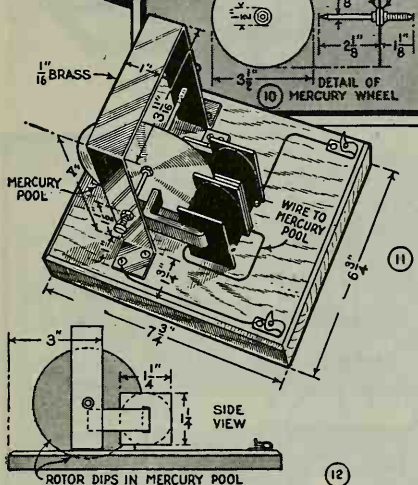
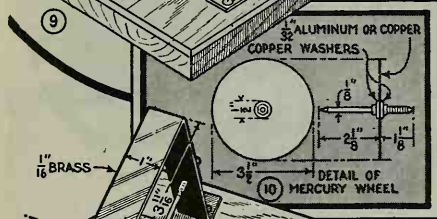
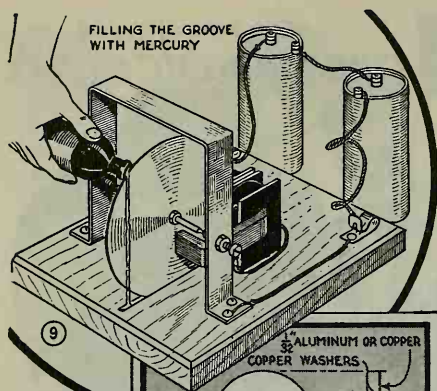
⑦

the baseboard at point A, Fig. 6. At this point connections to a transformer or battery are made. The other end of the wire is tacked to the yoke that supports the upper end of the rotor. A length of bare copper wire is used as a brush, rubbing lightly against the edges of the rotor about $\frac{1}{2}$ in. above the base. It is formed to a coil to provide flexibility. The other end of the brush wire is bared and formed into a binding-post coil at point B to which the other side of the transformer or battery is connected. Center-punch marks are made in the yoke and in a small tin base plate, halfway between the two nails. Then the rotor is set in place so that the arms are about $\frac{1}{8}$ in. above the tops of the nails. The brush is adjusted so that it touches the edges of the rotor and also releases before the arms pass over the nail heads. After connecting the motor to the current supply, give the rotor a start by turning it and the motor should run.

Synchronous Motor: A synchronous motor is one that operates at a constant speed, which is equal to or a submultiple of the frequency of the alternating current supplied to it. A simple synchronous motor



⑧ SERIES MOTOR



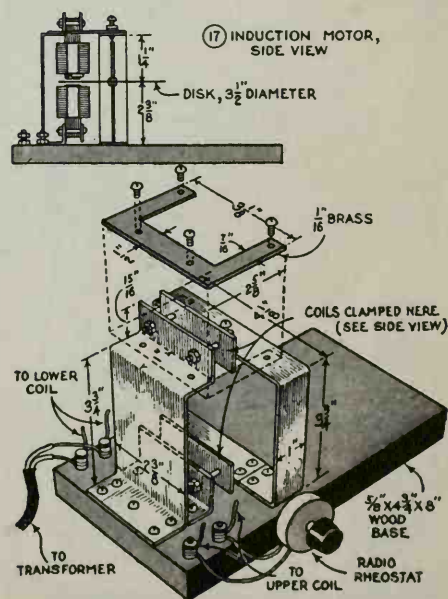
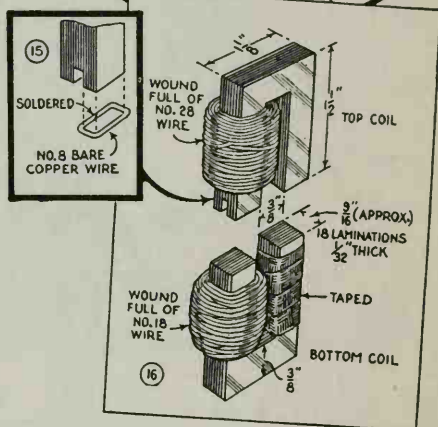
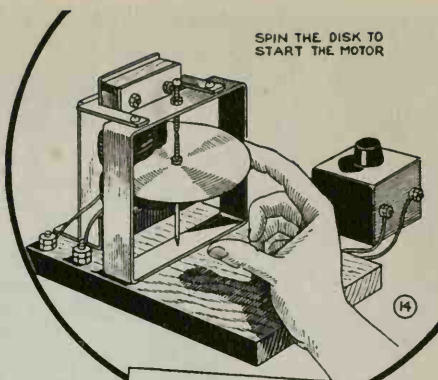
operating on low-voltage a.c. from a bell transformer is shown in Figs. 1 and 3. The field coils A and B are two magnets from a buzzer or doorbell placed so that the windings run in the same direction. These are connected in series. The rotor consists of two pieces of steel clock spring and the shaft is a No. 6-32 machine screw filed to a point at each end. Two nuts hold the springs to the shaft as shown. The shaft is pivoted between center-punched marks in the base plate and the supporting arm. There is no electrical connection to the rotor of this motor. The motor will continue to operate at about the speed at which it is started.

Series Motor: The motor shown in Fig. 5 runs on 6 volts d.c. or 8 to 12 volts a.c. from a toy transformer, and it can be fitted with a pulley to operate small models or other devices, delivering considerable power for its size. Details of construction are shown in Fig. 8. The armature and field cores C and D, as well as the end supports A and B, are made of $\frac{1}{8}$ -in. strap iron. Armature and field coils are wound with bell wire which approximately should fill the space. The armature is slipped on the shaft and is held in place by peening or with a drop of solder. The commutator is made from a thread spool and two strips of copper. Slots are sawed in opposite sides of the spool, the edges of the copper strips are inserted into the slots, and the strips are bent around the spools. There should be about $\frac{1}{4}$ to $\frac{3}{8}$ -in. clearance between the two copper segments. The edges of the commutator should be wrapped securely with strong cord. The leads from the armature coil are soldered to the two copper segments of the commutator, and the armature is put in place. Two washers are soldered to the shaft on either side of the end support to limit end play. The brushes are made of spring brass, $\frac{1}{2}$ in. wide. It may be necessary to give the motor a start by hand. If it does not run as first assembled, turn the commutator on the shaft to a position which will cause the motor to take hold.

Mercury-Pool Motor: The mercury-pool motor shown in Figs. 7 and 9 is a type used in d.c. watt-hour meters and other meters. It operates on two or three dry cells connected in series. It will not operate on a.c. Details of construction are shown in Figs. 9 to 13 inclusive. The rotor is a disk of $\frac{1}{32}$ -in. aluminum or copper mounted on a

small shaft which is placed between two machine screws which are center-punched at one end to serve as bearings and are locked to the frame with nuts. The mercury pool is cut in the wooden base, directly under the rotor. Next, an electromagnet is made. The core is $\frac{1}{4}$ -in. flat iron bent as shown in Fig. 13 and the two coils are wound full of No. 18 or No. 22 magnet wire, a spacer being placed between them. Both coils must be wound in the same direction. The electromagnet is mounted so that the rotor revolves freely between the coils, and the poles of the magnet are directly below the shaft of the rotor. Electrical connections are shown in Fig. 11. One terminal is connected to the coil, and the other side of the coil is connected to a wire dipping into the mercury pool. The rotor also dips into the pool. The second terminal is connected to the frame of the motor.

Induction Motor: Operated on low-voltage a.c. from a toy transformer, the disk-type induction motor shown in Fig. 4 exemplifies a principle used in meters of various types. It will not operate on d.c. Details of parts are given in Figs. 14 to 17 inclusive. The laminations used are approximately of the dimensions shown in Fig. 17 and can be obtained from an old audio transformer used in radio. Two stacks of laminations, each $\frac{1}{16}$ in. thick, are required for the lower and upper coil. The upper coil is wound with No. 28 d.c.c. wire, enough wire being wound on the coil to fill the winding space on the core. The lower coil is wound with No. 18 wire. The leads from each coil are brought out to a pair of binding posts on opposite sides of the motor. The core of the upper coil is drilled directly below the coil and a single turn of No. 8 bare copper wire is inserted as shown in Fig. 15. The ends of this wire should be lapped carefully and soldered together. The frame is made of No. 16-ga. sheet brass. The rotor is a disk of sheet copper or aluminum. It is moved up or down on the shaft until it is in the proper position between the two cores. The upper coil terminals are connected to a radio rheostat and the lower coil is connected to the transformer supplying 6 volts. It will be necessary to shift the upper coil slightly to one side or the other in order to get the motor to operate properly. Once the proper position has been found, the speed can be controlled by adjusting the rheostat.



TRACTOR

To keep a tractor in good condition, it's the daily service routine that counts. Careful attention to the simplest service details helps to cut down the big repair bills and is certain to result in much longer periods of peak efficiency and trouble-free service

RULES FOR SAFE TRACTOR OPERATION

1. Be sure the gear shift lever is in neutral before cranking the engine.
 2. Always engage the clutch gently, especially when going up a hill or pulling out of a ditch.
 3. When driving on highways, or to and from fields, be sure that both wheels are braked simultaneously when making an emergency stop.
 4. Always ride on seat or stand on platform of tractor. Never ride on drawbar of tractor or drawn implement.
 5. When tractor is hitched to a stump or heavy load, always hitch to drawbar and never take up the slack of chain with a jerk.
 6. Be extra careful when working on hillsides. Watch out for holes or ditches into which a wheel may drop and cause tractor to overturn.
 7. Always keep tractor in gear when going down steep hills or grades.
 8. Always drive tractor at speeds slow enough to insure safety, especially over rough ground or near ditches.
 9. Reduce speed before making a turn or applying brakes. The hazard of overturning the tractor increases four times when speed is doubled.
 10. Always stop power take-off before dismounting from tractor.
 11. Never dismount from tractor when it is in motion. Wait until it stops.
 12. Never permit persons other than the driver to ride on tractor when it is in operation.
 13. Never stand between tractor and drawn implement when hitching. Use an iron hook to handle drawbar.
 14. Do not put on or remove belt from belt pulley while the pulley is in motion.
 15. Should motor overheat, be careful when refilling radiator.
 16. Never refuel tractor while motor is running or extremely hot.
 17. When tractor is attached to a power implement be sure that all power-line shielding is in place.
- (Prepared by the Farm Safety Committee of the Farm Equipment Institute and approved by the National Safety Council)

YOU DON'T have to be an experienced mechanic to do the simple service jobs recommended by the manufacturer of your tractor. The important thing is to make sure that a maintenance schedule is carried out day in and day out. This schedule must include all parts that require periodic attention. It won't do to check fuel, oil, water, air pressure in the tires, grease daily, and then, for example, neglect to service the air cleaner or check the level of the battery solution at the proper time. It's a good idea to keep written records of service on those parts that require attention over longer periods of time.

Fig. 1 gives a maintenance schedule, which, of course, does not agree in every detail with recommendations by various manufacturers, due to the varying designs of tractors and parts, but it does show the importance of attention at regular intervals. Equal in importance to the regular schedule of maintenance is periodic attention to the proper condition of the six parts shown in Fig. 2. Neglect of any one of these will cause a waste of fuel and oil, which will result in undue wear and unsatisfactory operation of the tractor within a comparatively short time. The operator who fails to clean and grease the magneto or distributor at the proper time, add distilled

MAINTENANCE

① EVERY 10 HOURS

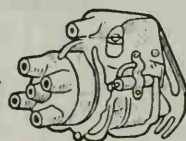
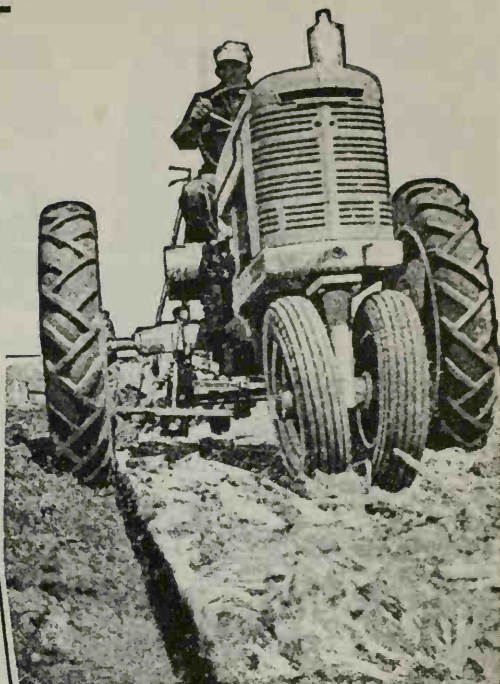
1. Air Cleaner—wash and refill oil reservoir. Clean top screen.
2. Lubricate—grease fittings.
3. Crankcase—check oil level.
4. Cooling System—check water and antifreeze.
5. Breather Cap—wash in gasoline or clean as recommended in instruction manual.
6. Fuel Filter—inspect and clean if necessary.
7. Tire Pressures—inflate to proper pressure.

EVERY 20 TO 60 HOURS

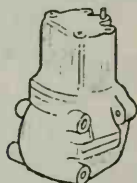
1. Battery—wipe away dust, check solution level, add distilled water when required. Cool terminals with vaseline if necessary.
2. Front Wheel Bearings—lubricate with grease gun if provided with pressure grease fittings.
3. Bolts and Nuts—check with wrench every 60 hours for tightness.
4. Radiator—inspect and clean out dirt and chaff.

EVERY 100 TO 600 HOURS

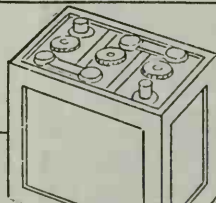
1. Transmission and Differential—change gear oil in new tractor after 200 hours; then every 600 hours. Use oil of recommended viscosity.
2. Crankcase Oil—change at 200 hours or under if oil shows dark on dipstick. Use oil of recommended viscosity.
3. Oil Filter—renew cartridge when oil is changed.
4. Front-Wheel Bearings—(not equipped with grease fittings) pack with proper grease and adjust bearings.
5. Generator—few drops of light oil in bearings every 100 to 300 hours as recommended in instruction manual.
6. Air Cleaner—remove whole assembly and clean thoroughly including element. When working in continued dusty conditions, every 100 hours.
7. Cooling System—drain and flush every 100 to 200 hours, or twice a season.
8. Sparkplugs—clean and check gap every 200 hrs.
9. Distributor and Magneto—inspect every 200 hours. Clean breaker-point chamber and check clearance of points. Dress points if necessary.
10. Pneumatic Tires—wash, clean and inspect treads for cuts and other defects. Repair if necessary.



MAGNETO



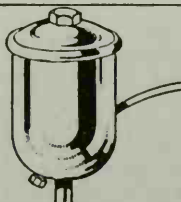
DISTRIBUTOR



BATTERY



SPARK PLUGS



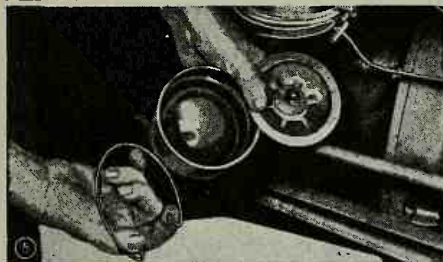
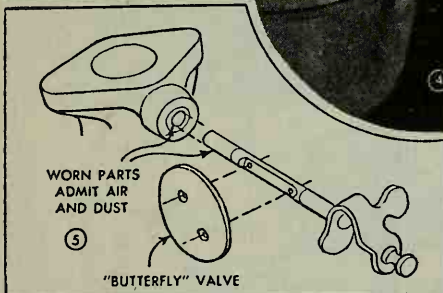
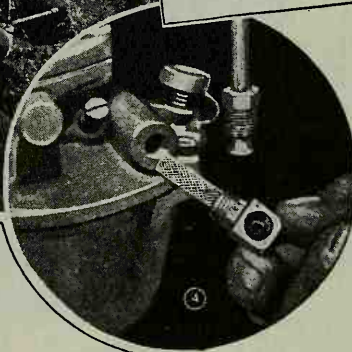
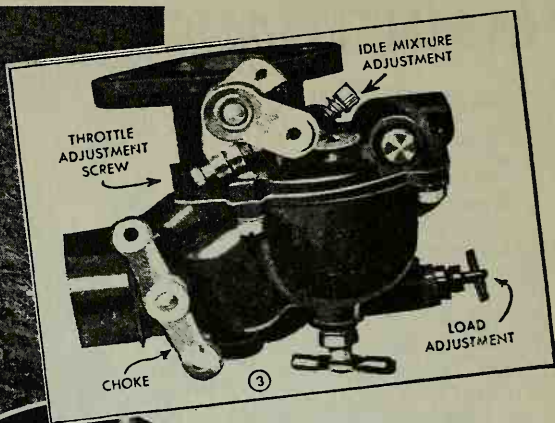
OIL FILTER



PNEUMATIC TIRES

water to the battery, re-gap spark plugs or replace them if necessary, change the oil filter and keep tires inflated to proper working pressures, is heading for trouble as several of these parts, such as battery, tires, and spark plugs deteriorate very rapidly with neglect. Improperly adjusted distributor and magneto points, wiring fouled with an accumulation of oil and dirt, a weak coil and dirty plugs not only result in a loss of power and more rapid wear in the engine but cause it to use an excessive amount of fuel.

Carburetors on most tractors have two adjustments, the idling adjustment and the main-jet or "load" adjustment. To obtain maximum fuel economy it's important that the carburetor be adjusted properly. Fig. 3 pictures a carburetor typical of those on tractor engines. Usually the approximately correct adjust-

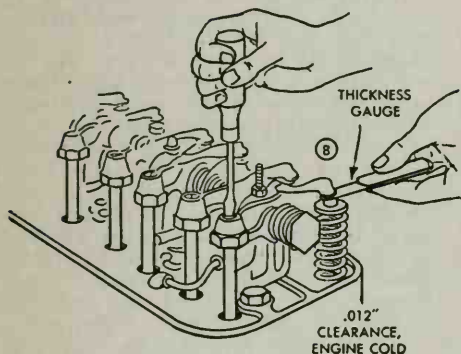
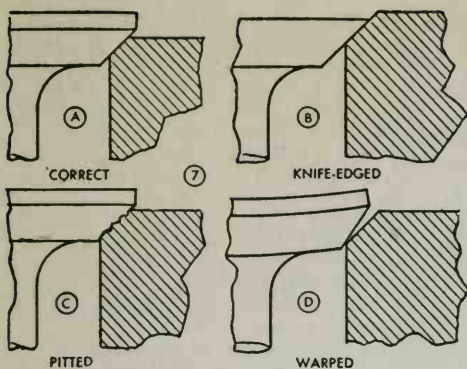


the engine picks up speed quickly and uniformly the adjustment is probably correct. But if the engine "skips" or "coughs," open the screw $\frac{1}{8}$ of a turn at a time until it picks up smoothly when the hand throttle is opened. To adjust for smooth idling, warm the engine to operating temperature, close the throttle and turn the idle-adjusting screw in until the engine begins to

run irregularly, and the exhaust sounds "rough." Then open the screw slowly, noting operation of the engine. By slow adjustment of the screw you'll find the point where the engine "smooths out," provided of course, all other parts are in proper condition. At regular intervals during the more seasonal service periods, drain the fuel tank through the carburetor and clean the fuel-filter sediment bowl and also the tiny screen at the fuel inlet to the carburetor, Fig. 4. This screen should be cleaned carefully with gasoline. While going over the carburetor, especially on older tractors, examine the throttle and choke linkage. If the small shafts carrying the "butterfly" choke and throttle valves are worn badly there may be openings large enough to admit air and dirt directly into the carburetor and intake manifold, Fig. 5.

As dirt and dust are enemies of all machinery, manufacturers have made every effort to keep it out of differential and transmission housings and particularly the engine. That's why frequent servicing of the air cleaner, Fig. 6, is so important. Under extremely dirty conditions it is advisable to service the cleaner at least twice daily. This means a thorough washing in distillate, or the so-called "white" gasoline,

ment for the main jet will be given as $1\frac{1}{4}$ turns of the screw from the closed position. Consult the instruction manual for the correct number of turns, as this may vary. In any case, if the mixture is too lean it tends to cut down power, which causes overheating. Although not conclusive, a simple field test for proper carburetor adjustment is to suddenly pull the hand throttle wide open when the engine is under load. If

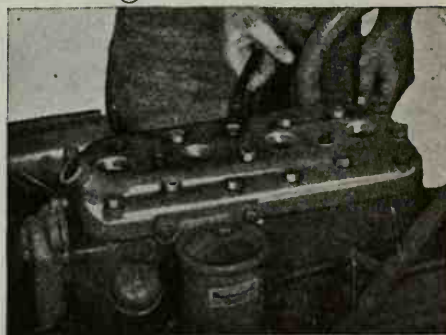


and filling with clean, unused oil of the viscosity recommended by the manufacturer of your tractor. Check frequently to see that there are no air leaks in the tube leading from the air cleaner to the carburetor.

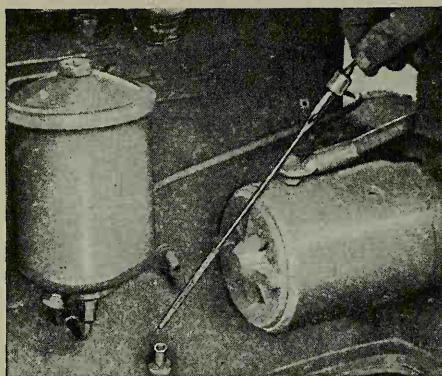
In Fig. 7, detail A shows how a valve should seat, and details B, C, and D show three common defects. For purposes of illustration, the details are exaggerated and, of course, a badly burned and pitted valve body does not always appear as in detail C. Valves ground to a knife edge as in detail B are sure to burn and pit in a very short time. Warped, pitted and knife-edged valves should be replaced. In later-type tractor engines fitted with valve-seat inserts the valves are usually refaced on special equipment when service is necessary. However, in older engines the valves are generally ground with hand equipment as in Fig. 9. Fig. 8 details the common method of setting clearances on engines having "overhead" valves. When setting valves after grinding them, it is necessary to set the clearance twice, as it generally is recommended that the cylinder head be tightened in two stages, the second time after some hours of operation. Therefore, it is necessary to reset the valve clearances after this second tightening of the cylinder head. The .012-in. clearance given in Fig. 8



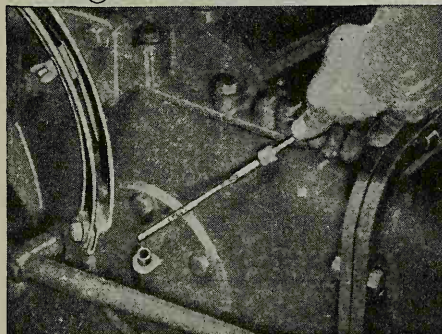
⑩ SCRAPE AWAY CARBON



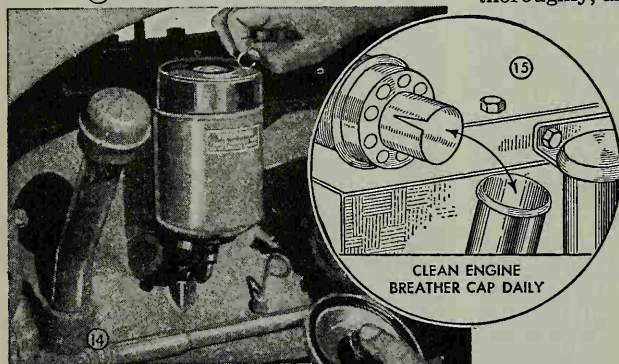
⑪ TIGHTEN HEAD UNIFORMLY



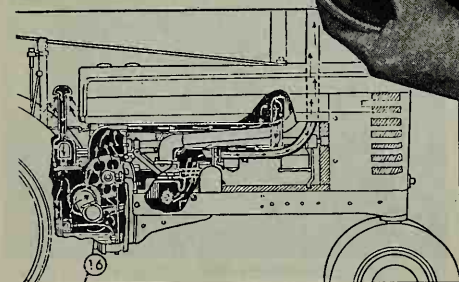
12 CHECK CRANKCASE OIL DAILY



13 KEEP GEAR OIL TO PROPER LEVEL



CLEAN ENGINE
BREATHER CAP DAILY



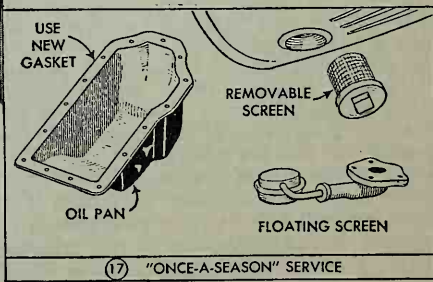
16

is not universal. Refer to your instruction manual for the recommended clearance. Whenever the cylinder head is removed, scrape away all carbon, as in Fig. 10. When replacing the head, use a new gasket and be careful to tighten the nuts uniformly, Fig. 11, and in the order recommended by the manufacturer. This is important because it's the only way to be sure the head fits squarely on the cylinder block. After the engine has been run for some time, it's a good idea to go over the nuts again and a general recommendation is to tighten with a torque-indicating wrench to a 50-foot-pound tension.

Some tractors are equipped with two dipsticks, one for the crankcase, Fig. 12, and one for the transmission and differential, Fig. 13. Checking oil levels and changing the oil-filter cartridge, Fig. 14, are important service operations. This is especially true of the filter cartridge. Therefore, it is a good idea to keep a record of the changes. More likely to be overlooked at the regular service checks, however, is the engine breather cap. Fig. 15 shows one type, Fig. 16 another, the latter operating on a somewhat different principle. The caps are fitted with filter elements, which should be cleaned often. Some makers recommend once each day in dusty conditions. Fig. 17 shows two "once-a-season" service jobs. The first one is to remove the oil pan and clean it thoroughly, and the second one is to clean

the oil-pump screen. On some tractors you will find that the screen is attached to the oil-pan plug and is removed with it.

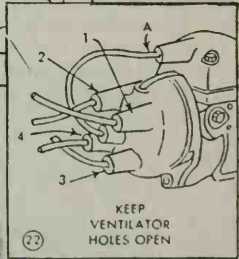
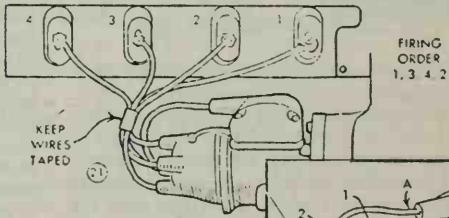
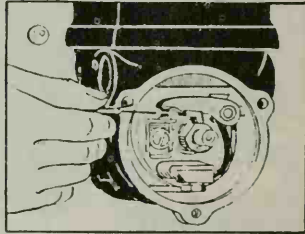
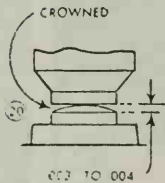
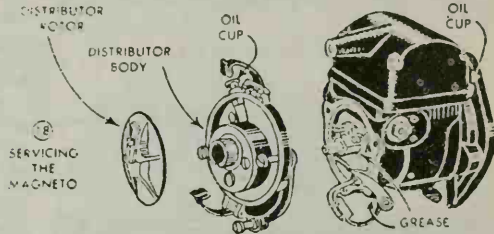
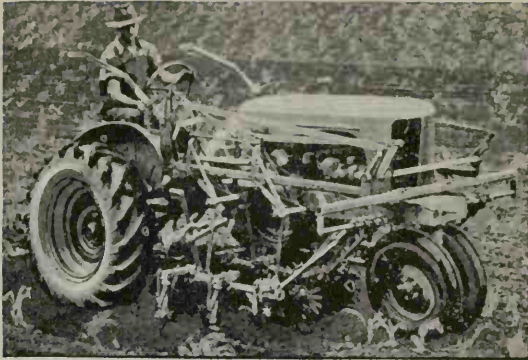
Due to the construction of magnetos on later-model tractors, minor servicing is limited to a few drops of oil at regular intervals on the impulse coupling and the distributor shaft, a small quantity of grease on the breaker cam, and an occasional dressing and ad-

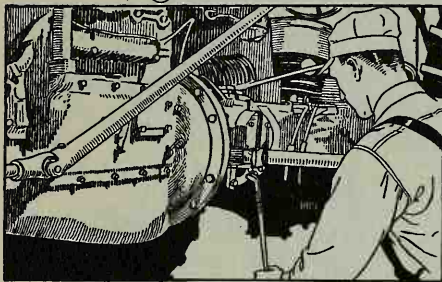
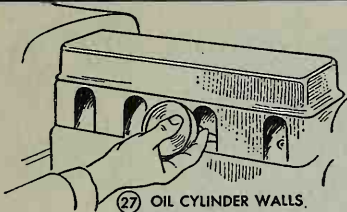
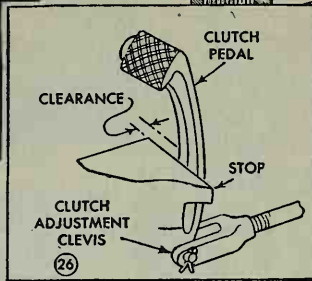
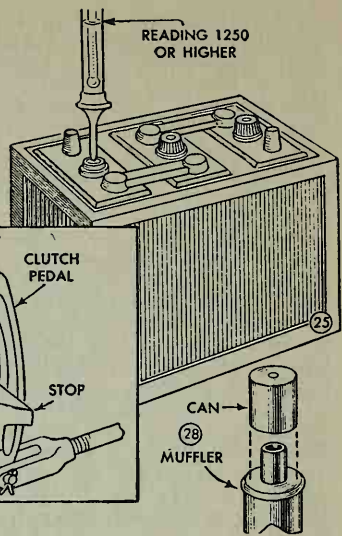
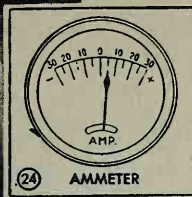
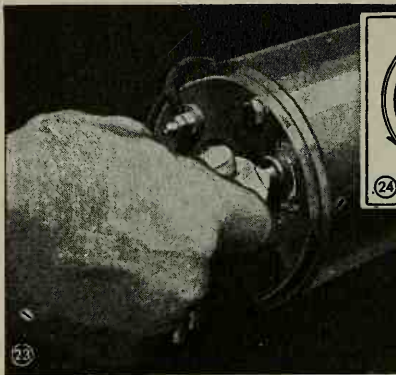


17 "ONCE-A-SEASON" SERVICE

justing of the breaker points. Figs. 18 and 19 show this type magneto partly disassembled. It's important to keep the breaker-arm chamber clean, as an accumulation of oil and dirt causes rapid wear. The chamber should be inspected at regular intervals and the points checked with a thickness gauge as in Fig. 19. In dressing breaker points, use a sharp, fine file and crown one of the points as in Fig. 20. When you remove the distributor body, be sure not to crank the engine or it may be necessary to re-time the magneto. When it is necessary to remove the magneto, re-time and re-wire it according to the instruction manual. On later-type magnetos this usually is a simple operation, but you will have to know the firing order of the cylinders, Fig. 21. However, the firing order given is not universal. Lastly, be sure that Cable A in Fig. 22, is pushed firmly into the sockets and that the ventilator holes in the distributor cap are open. Usually it is best to take old-type magnetos to a skilled mechanic for service and repair.

On tractors equipped with battery ignition or with separate battery for starting and lighting, it is necessary to keep the generator-charging rate at the minimum which will assure a fully charged battery at all times. Adjusting the charging rate on most generators is done by changing the position of the third brush, some generators being equipped with a screw adjustment as in Fig. 23. By trial adjustment of the generator at the average engine speed you use in field work and frequent checks with a battery hydrometer, Fig. 25, you can determine the rate that will maintain a full charge without "boiling" the battery solution. Usually this will be





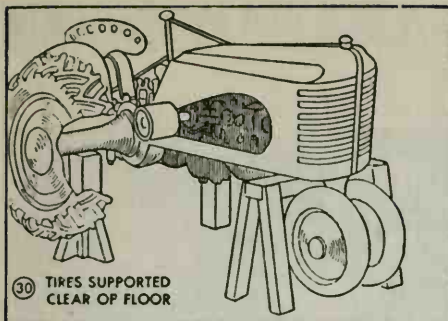
29 GREASE CLUTCH RELEASE BEARING

under 5 amps. as in Fig. 24, when the electrical system is in good condition.

An important periodic adjustment which should not be overlooked is clutch-pedal clearance shown in Fig. 26. An adjustment also is provided on tractors equipped with a hand-operated clutch. In either case the purpose of providing proper clearance is to prevent slippage due to the clutch not being fully engaged. On the foot-operated type of clutch the pedal-to-stop distance varies in the recommendations of different manufacturers. Refer to your instruction manual. And don't forget to grease the clutch-release bearing, as in Fig. 29, on tractors provided with an outside pressure-grease fitting. On some tractors this is a ball bearing of the grease-sealed type which requires no lubrication.

When the tractor is stored or must stand unused for more than 30 days, several precautions should be taken. Drain all fuel through the carburetor and if there is dan-

ger of freezing, drain the cooling system and flush it out with clean, soft water. Wash out the air cleaner and add fresh oil. This will prevent any accumulation of dirt settling and "caking" in the oil receptacle. Drain crankcase and oil filter, and if necessary, the transmission. Add fresh oil. Remove the battery and have it charged at regular intervals. Also remove the spark plugs and pour $\frac{1}{8}$ to $\frac{1}{4}$ pint of medium crankcase oil in each cylinder as in Fig. 27. Crank engine 40 to 50 turns, to distribute oil to all moving parts. Then remove the valve cover and "paint" the valve stems and springs with medium oil. Press a clean rag into the exhaust pipe or muffler and the breather pipe to prevent moisture entering the engine. Cover upright mufflers with a small can as in Fig. 28. Wash all mud and dirt from the tires and inflate to full recommended pressures and keep pressures up during the storage period. Fill any small cuts or breaks in the tire treads with a prepared cut filler. Before putting the tractor in service, re-oil the cylinders and valves as described, check tires, and don't forget to remove the rag plugs from exhaust and breather pipes. Where pneumatic-tired tractors must stand idle more than 30 days it will pay well to use wood supports, as in Fig. 30. These should be high enough to support the tractor with the tires clear of the floor. The front support can be made from 4 by 4-in. stock in the same way as an ordinary sawhorse. Usually, a single length of 4 by 4-in. stock will do for each rear support. Saw triangular-shaped wing braces and nail to opposite sides of one support as shown. Then when the tractor is jacked up, place the



supports in the position indicated. This arrangement will prevent tipping. After a tractor has stood for some time unused it's a good idea to loosen transmission and differential drain plugs so that any moisture which has collected in the housings can drain out. Be sure to tighten the plugs after draining. Also, it's a good idea to check them occasionally during the work season. Even though it may be necessary to partially replenish the solution several times during the season, continued use of a rust inhibitor will avoid a lot of trouble with the cooling system. Bugs, dirt, and chaff will collect in the radiator fins and must be washed out occasionally with a hose.

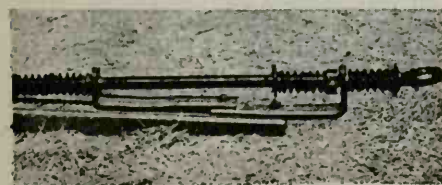
It's a good practice to keep a tractor reasonably clean. Scrape off accumulations of oily dirt and mud with a putty knife and wire brush, Fig. 31, and then wipe off with rags or a paintbrush soaked in gasoline, distillate, or kerosene. Always have tractor in the open while cleaning. If you use gasoline, don't scrub metal parts with a wire brush. Strike a spark from metal with the brush and you may have a serious fire. Many owners paint their tractors regularly, Fig. 32. It's a good practice and it pays to do a thorough job.



Photos and some details in this article by courtesy of Allis-Chalmers Co.—Caterpillar Tractor Co.—Harry Ferguson, Inc.—International Harvester Co.—J. I. Case Co.—John Deere Tractor Co.—Massey-Harris Co., Inc.—Minneapolis-Moline Power Implement Co.—Oliver Farm Equipment Co.

Spring-Cushioned Drawbar

When operating certain types of tractor-drawn farm equipment over rough ground or in terraced fields, a spring-cushioned drawbar snubs the violent forward and backward thrust on a loose-pinned hitch and also eases the tractor into the load



without a sudden jerk when starting. It is especially useful on tractor trailers hitched either singly or in tandem. As pictured, two heavy L-brackets are bolted to the drawbar. The ends are drilled to take the rod which carries the coil springs and an eye or clevis-type yoke at the outer end. The springs bear against the brackets and also against stops on the rod to give both forward and backward snubbing action.

TRANSFORMER

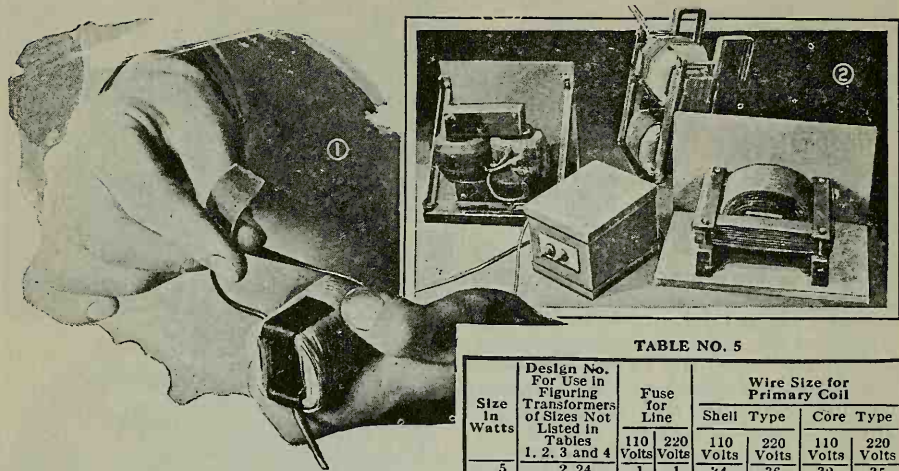


TABLE NO. 5

Size in Watts	Design No. For Use in Figuring Transformers of Sizes Not Listed in Tables 1, 2, 3 and 4	Fuse for Line		Wire Size for Primary Coil			
		110 Volts	220 Volts	Shell Type		Core Type	
				110 Volts	220 Volts	110 Volts	220 Volts
5	2.24	1	1	34	36	32	35
10	3.16	1	1	31	34	30	33
15	3.87	1	1	29	32	28	31
20	4.47	1	1	27	31	27	30
30	5.48	1	1	26	29	25	28
40	6.33	1	1	25	28	24	27
50	7.07	1	1	24	27	23	26
75	8.65	1	1	22	25	21	24
100	10.00	1	1	21	24	20	23
125	11.19	6	1	20	23	19	22
150	12.22	6	6	19	22	18	21
175	13.21	6	1	19	21	17	20
200	14.12	6	1	18	21	17	20
225	15.00	6	6	18	20	16	19
250	15.81	6	6	17	20	16	19
275	16.59	6	6	17	19	15	18
300	17.31	6	6	16	19	15	18
350	18.70	6	6	16	18	14	17
400	20.00	6	6	15	18	14	17
450	21.20	6	6	14	17	13	16
500	22.35	6	6	14	17	13	16
600	24.45	6	6	13	16	12	15
700	26.45	10	6	12	15	11	14
800	28.30	10	6	12	14	11	14
900	30.00	10	6	11	14	10	13
1000	31.60	10	6	11	14	10	13
1100	33.20	15	6	11	14	9	12
1200	34.60	15	10	10	13	9	12
1250	35.40	15	10	10	13	9	12
1300	36.00	15	10	10	13	9	12
1400	37.40	15	10	10	12	8	11
1500	38.70	15	10	9	12	8	11
1600	40.00	20	10	9	12	8	10
1700	41.20	20	10	9	12	8	10
1800	42.40	20	10	9	12	2 #10*	10
1900	43.60	20	10	8	11	2 #10*	10
2000	44.70	20	10	8	11	2 #10*	10

*Wind two #10 wires at the same time and use as 1 wire by connecting the starting ends together and the finish ends together.

TRANSFORMERS to suit any requirement can easily be built by carefully following the instructions contained in this article. There are two types of this apparatus, the shell and the core type, both shown in Fig. 2. They differ in that the former has its windings on a center cross-piece of the core and takes less copper, while the latter has the primary coil on one and the secondary on the other leg of the core. Cores may be built up from standard silicon-steel E and I-punchings, obtainable in many sizes, or assembled from strips of No. 26-gauge silicon steel, cut to size with tinners' shears.

The starting point in transformer design is the exact determination of the output required in watts, which is the product of amperes and volts. For example, a 6-volt transformer delivering 20 amp. has an output of 120 watts. Let us assume that we are going to build a shell-type transformer and that the frequency of our 110-volt supply circuit is 60 cycles. Referring to table No. 1, does not give the exact size of transformer desired, one of 120 watts, and therefore the next larger size is selected, which is 150 watts. The turns of wire required for the secondary coil is found by multiplying the turns per volt as given in table No. 1, by the volts required, which in this case is 6 volts times 1.98, or

11.76 turns. The next higher even number, or 12 turns, should be used.

Next, we should determine the size of wire needed for the secondary, which depends on the current to be passed, already known to be 20 amp. Multiply the amperes by 750 for the shell type, or by 1,000 for the core type to find the cross-sectional area of the wire in circular mils. In the example, this would be 15,000. Table No. 6 gives the wire sizes corresponding to the circular-mil area. As the figure 15,000 is not given, take the next one above it,

CONSTRUCTION

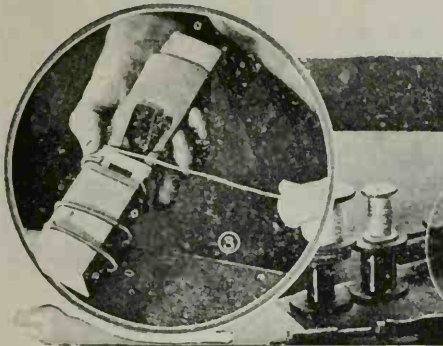


TABLE NO. 6—WIRE SIZES

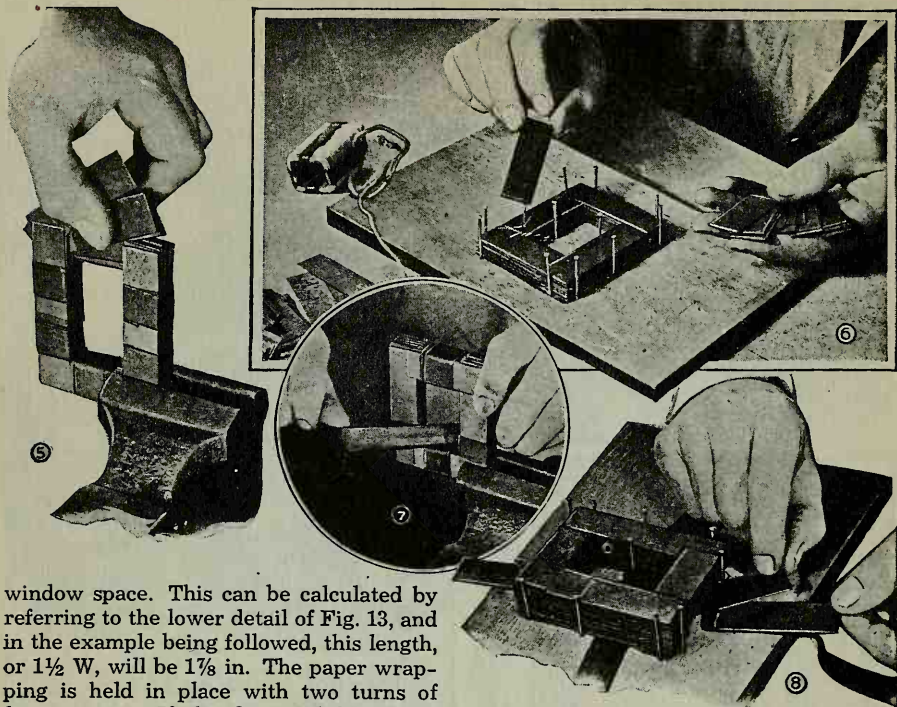
B & S Gauge No.	Circular Mils	Turns per Square Inch		Pounds of Wire per Cubic Inch	
		Single Cotton Covered	Enamel Covered	Single Cotton Covered	Enamel Covered
8	16510	55	53	.228	.253
9	13090	71	66	.227	.244
10	10380	87	83	.226	.236
11	8234	104	106	.224	.236
12	6530	138	135	.223	.238
13	5178	172	168	.220	.236
14	4107	196	215	.217	.231
15	3257	265	271	.214	.232
16	2583	331	345	.210	.226
17	2048	407	433	.207	.227
18	1624	493	545	.204	.227
19	1288	618	681	.200	.225
20	1022	719	852	.195	.223
21	810	836	1065	.190	.221
22	642	1064	1340	.183	.220
23	509	1362	1665	.177	.217
24	404	1615	2100	.170	.217
25	320	1946	2630	.164	.217
26	254	2385	3320	.157	.216
27	201	2810	4145	.150	.215
28	159	3462	5250	.143	.215
29	126	3760	6510	.135	.213
30	100	4713	8175	.128	.212
31	79	5535	10200	.120	.210
32	63	6137	12650	.110	.207
33	50	6920	16200	.101	.200
34	39	7960	19950	.093	.205
35	31	9243	25000	.083	.205
36	25	9723	31700	.075	.205

which is 16,510, corresponding to No. 8 wire, which is the correct size to use. How much wire is needed for the secondary coil depends on the size of the core on which it is to be wound, the number of turns already being known. To estimate the weight of wire needed, consult table No. 6, where we find that No. 8 s.c.c. wire will wind 55 turns per square inch. Dividing our turns, or 12, by this number we get .218 sq. in. as the cross-sectional area of the wire on the coil. Multiplying this number by the distance around the core, as found in table No. 1, we get $8\frac{3}{8}$ times .218, or 1.8, which is the number of cubic inches of wire needed for the coil. Table No. 6 also gives the number of pounds of No. 8 s.c.c. wire per cubic inch as .228. By mul-

tiplying this number by 1.8 cu. in. we get .46 lb., or the approximate weight of wire for the secondary coil.

The next step is to find the size of the core and its weight. From table No. 1 we find that the width of the core leg on which the coil is wound should be $1\frac{1}{4}$ in. This table also gives the thickness of the core as $2\frac{1}{16}$ in. and the approximate weight of silicon steel required as 5.8 lb. Fig. 13 shows how all the core dimensions are based on the width of the core leg which is indicated by W. It only remains to determine the turns, wire size and weight of wire required for the primary or input coil. Referring again to table No. 1 you will find that there are to be 212 turns, and that the winding will weigh about .9 lb. Refer to table No. 5 to find the size of wire needed, which in this case is No. 19.

The coils are wound on a wooden form, as in Fig. 4. The primary is wound first. The form is cut to a width and thickness slightly greater than the dimensions of the core, which in this case is $1\frac{1}{4}$ by $2\frac{1}{16}$ in., and is covered with two or three layers of heavy brown paper for a distance equal to the length of the coil, which in turn is made $\frac{1}{4}$ in. less than the length of the



window space. This can be calculated by referring to the lower detail of Fig. 13, and in the example being followed, this length, or $1\frac{1}{2} W$, will be $1\frac{1}{8}$ in. The paper wrapping is held in place with two turns of friction tape. If the first and last three turns of each layer of wire are wound over a length of friction tape, and this is doubled back over the coil, as shown in Fig. 3, the end turns will be securely held in place. A thin sheet of tough paper should be wound between layers of wire if space permits. If there is not room for this, use a sheet between every other, or every third layer. When the primary coil has been completed, cover it with two layers of heavy brown paper and wind on the secondary coil. Great care should be taken to prevent contact between the two coils. When completed, they are slipped off the form and bound with tape, as in Fig. 1. The core is then slipped into the coils, as shown in Fig. 12. After the core and coil have been assembled, they should be impregnated with orange shellac or electrical-coil varnish. If orange shellac is used, dilute it with an equal volume of alcohol. A large can will serve as a dipping tank. Allow the assembly to soak for about 12 hours, after which it is left to dry thoroughly for an equal period. To complete the drying, bake the transformer at a low

heat for 2 or 3 hours. Shell-type transformers may be completed by bolting on a pair of standard pressed-steel end plates obtainable in various sizes corresponding to the core punchings shown in Fig. 12.

Core-type transformers are easily assembled in a jig, as in Fig. 6, the strips being piled alternately, as shown in the detail above table No. 7. The cores must be bound together and securely taped while held in a vise to avoid hum. Figs. 7 and 8 show the steps for binding a core of this type. The coils are wound separately and slipped on each leg of the core, as in Fig. 10. To do this, remove the laminations from one side of the core, as shown in Fig. 5, replacing these, as in Fig. 9, after the coils have been placed in position. A mallet or block is used, as in Fig. 11, to force the laminations down evenly, after which they are taped securely. The transformer may be clamped with channel iron or angle-iron brackets, as shown in Fig. 14, and mounted in a metal box, as in Fig. 16. The cord, which connects the transformer to the supply circuit should be

The image contains four numbered photographs illustrating the construction of a device:

- 9**: A close-up of electronic components, including a transformer and capacitors, being assembled on a dark base.
- 10**: A hand is shown adjusting a component, possibly a potentiometer or a switch, on the assembly.
- 11**: A hand is shown holding a component, likely a transformer, and positioning it on the base.
- 12**: A hand is shown connecting wires to the components, completing the wiring of the device.

If you need a size of transformer not covered in the tables, refer to table No. 5. Locate the desired size, or the nearest one of higher value, in the first column. Opposite this size is a design number needed for figuring the other values. This table also gives the wire size to be used for the primary coil. Let us assume that you want to build a core-type transformer to convert 110 volts to 220 volts on a 60-cycle circuit, and that you will need 5 amp. from the secondary. The watts will be 5 times 220 or 1,100. Consulting table No. 5,

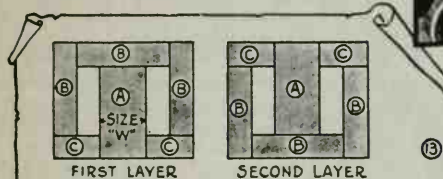
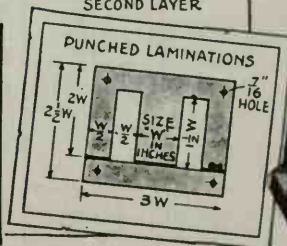
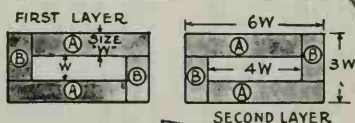
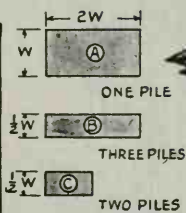


TABLE NO. 7

DIMENSIONS FOR SHELL TYPE OF TRANSFORMER STEEL		
Size "W"	Area of 1 Window In Sq. In.	Weight of Core 1" Thick Lb.
$\frac{1}{8}$ "	.29	.50
$\frac{3}{16}$ "	.42	.73
$\frac{1}{4}$ "	.57	.99
$\frac{5}{16}$ "	.92	1.30
$\frac{3}{8}$ "	1.16	2.03
$\frac{7}{16}$ "	1.41	2.46
$\frac{1}{2}$ "	1.68	2.92
$\frac{9}{16}$ "	1.97	3.44
$\frac{5}{8}$ "	2.27	3.96
$\frac{11}{16}$ "	2.62	4.58
$\frac{3}{4}$ "	3.00	5.20
$\frac{13}{16}$ "	4.22	6.53
$\frac{7}{8}$ "	4.50	8.25
$2\frac{1}{8}$ "	5.60	9.90
$2\frac{1}{4}$ "	6.70	11.70
$2\frac{3}{8}$ "	9.20	15.90
$2\frac{1}{2}$ "	12.00	20.80
$2\frac{7}{8}$ "	15.20	26.40

TABLE NO. 8

Size "W"	Dimensions of Core		Area of Window Sq. In.	Wt. of 1" Thick Core
	A	B		
$\frac{1}{8}$	$1\frac{1}{8} \times 4\frac{1}{8}$	$1\frac{1}{8} \times 1\frac{1}{8}$	3.06	2.9
$1\frac{1}{16}$	$1\frac{1}{8} \times 5\frac{1}{8}$	$1\frac{1}{8} \times 2$	4.00	3.8
$1\frac{1}{8}$	$1\frac{1}{8} \times 5\frac{1}{8}$	$1\frac{1}{8} \times 2\frac{1}{8}$	5.06	4.8
$1\frac{1}{4}$	$1\frac{1}{8} \times 6\frac{1}{8}$	$1\frac{1}{8} \times 2\frac{1}{8}$	6.25	5.9
$1\frac{3}{8}$	$1\frac{1}{8} \times 7\frac{1}{8}$	$1\frac{1}{8} \times 3$	7.55	7.2
$1\frac{1}{2}$	$1\frac{1}{8} \times 8\frac{1}{8}$	$1\frac{1}{8} \times 3\frac{1}{8}$	10.60	10.1
$1\frac{5}{8}$	$1\frac{1}{8} \times 9\frac{1}{8}$	$1\frac{1}{8} \times 3\frac{1}{8}$	12.5	11.6
$1\frac{3}{4}$	2×10	2×4	14.1	13.3
2	$2 \times 11\frac{1}{2}$	$2 \times 4\frac{1}{2}$	16.0	15.2
$2\frac{1}{4}$			20.25	19.1



SHELL-TYPE TRANSFORMERS, TABLE NO. 1-50 TO 133 CYCLES

[illegible]

SHELL-TYPE TRANSFORMERS, TABLE NO. 2-25 TO 40 CYCLES

Select Size and Purpose	Primary Coil			Secondary Coil			Check to See if Your Coils Will Fit Space
	For 10 Volts		For 220 Volts	Turns of Wire		Approximate Weight in Pounds	
	Turns of Wire	Approximate Weight of Wire in Pounds	Turns of Wire	Approximate Weight of Wire in Pounds	Turns of Wire	Approximate Weight of Wire in Pounds	
50	565	0.8	1,100	0.7	5.23	2.2	19
100	400	1.2	800	1.0	3.70	3.4	11
150	327	1.7	654	1.6	3.02	5.5	7.5
200	283	2.0	566	1.9	2.62	6.4	6.7
250	253	2.2	506	2.1	2.34	7.1	6.0
300	230	2.5	460	2.4	2.13	8.0	5.4
350	210	3.0	400	2.6	1.85	9.0	5.0
400	200	3.6	358	3.4	1.66	10.0	4.6
500	179	4.4	328	4.0	1.52	11.9	4.1
600	164	4.6	302	4.4	1.40	11.9	3.8
700	151	4.8	282	4.8	1.30	12.7	3.5
800	134	6.4	258	6.2	1.23	14.2	3.3
900	127	6.4	234	6.0	1.17	15.5	3.1
1000	127	7.0	208	6.9	1.08	17.4	3.0
1250	117	8.3			.96		
1500	104	8.3					

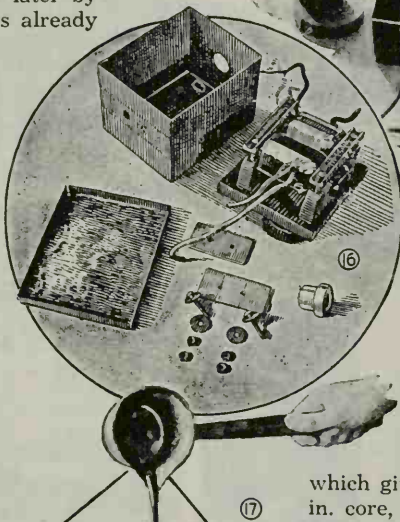
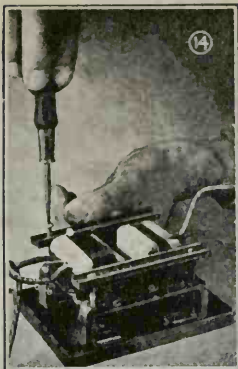
CORE-TYPE TRANSFORMERS, TABLE No. 3-50 TO 133 CYCLES

[illegible]

CORE-TYPE TRANSFORMERS. TABLE No. 4-25 TO 40 CYCLES

[illegible]

you find the design number for 1,100 watts to be 33.20, and that the primary coil should be wound with No. 9 wire. Remembering this, you turn to table No. 3, which contains formulas for calculating 60-cycle, core-type transformers. In the space under the first column listing the size in watts, write 1,100, which you have already found. For the second column divide the design number, or 33.20, as found in table No. 5, into 8,200 and you will get 247 for the number of primary turns. The weight of primary wire for the next column, and the weight of secondary wire may be calculated later by the same method as has already been outlined. The secondary turns per volt is next determined by dividing 75 by the design number, in this case 33.20, which gives 2.25. Likewise, multiplying .093 of the next column by 33.20 gives 3.08 for the cross-sectional area of the core. To decide on a core size, look up the column and select a size proportional to those given for other sizes of transformers. In this case $1\frac{5}{8}$ in. will be satisfactory. The



thickness of core needed can now be figured by dividing the area already found, or 3.08, by the core size, or $1\frac{5}{8}$ in., which gives 1.89, although we can use a $1\frac{1}{2}$ -in. core to make it even. The weight of steel needed can be found by referring to table No. 8,

which gives the weight of a $1\frac{5}{8}$ -in. core, 1 in. thick. Multiplying the thickness of the core, or $1\frac{1}{2}$ by 10.1, gives approximately 19½ lb. as the core weight. With these new values for table No. 3, you can proceed to design the 1,100-watt transformer by the same method as was used for the 150-watt outfit. However, the 1,100-watt transformer will have more turns on the secondary than on the primary, and is therefore a step-up transformer. Special care should be used to assure good insulation when high-voltage coils are built.

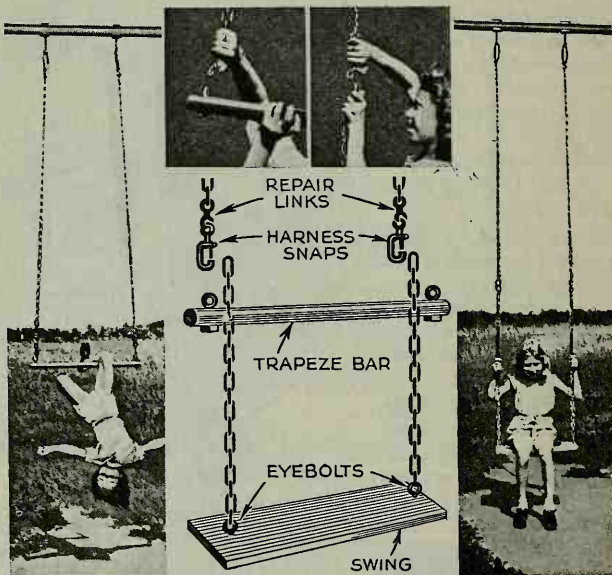
When designing transformers, one should always check the window space of the core to make sure that it is large enough. If the coil requires more space, select a core of the next larger size. In

changing the core size, divide the cross-sectional area of the core, as given in tables No. 1 to 4, by the width of the new core, to find the proper thickness to use. For low-voltage transformers, where the amperage is high, it is best practice to wind several small wires side by side at the same time, connecting them together at each end, instead of using a single large wire. The total circular-mil area of the small wires must be equal to that of the single wire for which they are substituted.

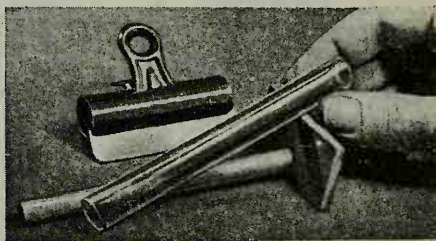
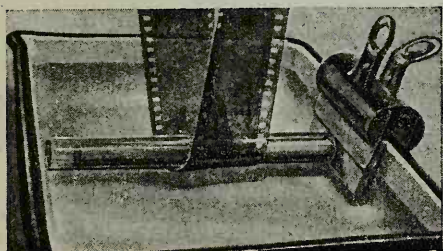
Welding transformers, passing several hundred amperes, should have secondary windings of heavy copper ribbon or strips of sheet copper. To figure the number of amperes a strip of copper can carry safely, multiply the width by the thickness to get the cross-sectional area in square inches, and multiply this product by 1,275. Copper ribbon or strips of sheet copper are insulated before winding by wrapping them with plain linen tape or strips of varnished cloth. Splices must be soldered.

TRAPEZE-SWING

On swings that have chains instead of ropes, it is possible to make the swing seat and a trapeze bar interchangeable by using a repair link and a heavy harness snap in each chain at the height the trapeze bar is to be attached. Two links are removed from each chain so the length will remain the same. Eyebolts are fitted to the trapeze bar, the ends of the screws being peened so the nuts cannot come off. The arrangement of fastening the chain to the seat with eyebolts as shown, can be improved by providing yokes or hangers of an inverted V-shape at the ends of the seat to prevent tipping easily when children stand on it.



TRAY DEVELOPER



Roll film can be developed in a tray with less developer than is used in a tank. All you need is a roller over which the film can be moved up and down in the solution, emulsion side out. A common glass tube or a test tube is slipped over a length of dowel, which is bradied to a small piece of wood clamped to the tray by a spring paper clip.

TREE BRACING

BEFORE you cut down the venerable shade tree that's showing signs of old age, take time to examine it closely. Cabling and rod bracing may save it for many more years of usefulness by providing mechanical support for weakened crotches and large, spreading branches.

Tight V-crotches are a frequent source of trouble in both young and old trees which grow with multiple, or divided, trunks. Major limbs that begin growth very nearly parallel to each other often develop a seam, or joint, of nonconnecting tissue at the division point. This results from the squeezing and crushing of the cambium layer and bark as growth progresses. Eventually the affected tissues die, leaving an open seam. When the limbs become loaded with ice, or when the foliage is thoroughly wet down by a heavy rainstorm, the joint may break and cause irreparable damage to the tree.

A second ranking source of trouble in older trees is a decayed or damaged trunk caused by a fungus attack or partially healed wounds. Sometimes trunks and large limbs will be split by the twisting stresses of high winds or sleet storms. Such damage should be repaired immediately or the tree will be lost.

The two general methods of tree bracing are cabling and rod bracing. Although each tree presents an individual problem, the two methods have several common applications. Where trees stand in close proximity, inter-tree cabling combined with rodding, Fig. 1, is frequently used to stabilize younger trees and promote proper top formation. In older trees the methods are sometimes combined to distribute stresses which might cause damage to the individual trees, especially in open, windswept locations on large lawns or estates.

Utilizing the same principle, inter-branch



cabling of several types is used to support the tops of large individual trees. Typical applications are shown in Fig. 2. The cables are installed high in the branches to equalize the load on structurally weak crotches. As a rule, the most efficient for general use is the triangular system, Fig. 2. When the cables are installed care must be taken to locate them so that they do not touch other branches or the trunk of the tree as damage may result.

The location of the cables in relation to the length of the branches depends to some extent on the structure of the tree, but it's

Where trees of the same age are grouped closely together, inter-tree cabling frequently is used to stabilize growth and aid top formation. Large, individual trees are often guyed with cables, as in left-hand detail



GUYING



1



INTER-TREE CABLING

a safe rule to place the screw eyes, or lags, about $\frac{3}{8}$ the distance from the crotch to the end of the limb. Holes for the screw eyes should be drilled so when the eyes are installed the parts will be in a straight line. Otherwise the screw eyes will be bent when subjected to strain. After measuring the distance between the screw eyes to determine the length of each cable, it is cut to length and eye-spliced as in Fig. 4, A, B, C and D. For average spans, $\frac{1}{4}$ -in. cable is suitable for supporting limbs up to 6 in. in dia. For larger limbs, use $\frac{5}{16}$ or $\frac{3}{8}$ -in. cable.

After installation, the cables should be under sufficient tension to hold them taut when the limbs are swayed by wind. To accomplish this, the limbs are roped to the tree trunk and raised somewhat above their normal position before cabling. In some cases this will require the aid of a tackle block.

Fig. 3 illustrates three methods of rod bracing in common use. To avoid weakening the limbs, the single-bolt method is the most widely used as it requires drilling only one hole in each of the limbs affected. The rod used is continuously threaded with a square thread similar to a lag screw. Usually it is cadmium-plated and comes in sizes ranging from $\frac{5}{8}$ to 1 in. in dia. Ordinarily

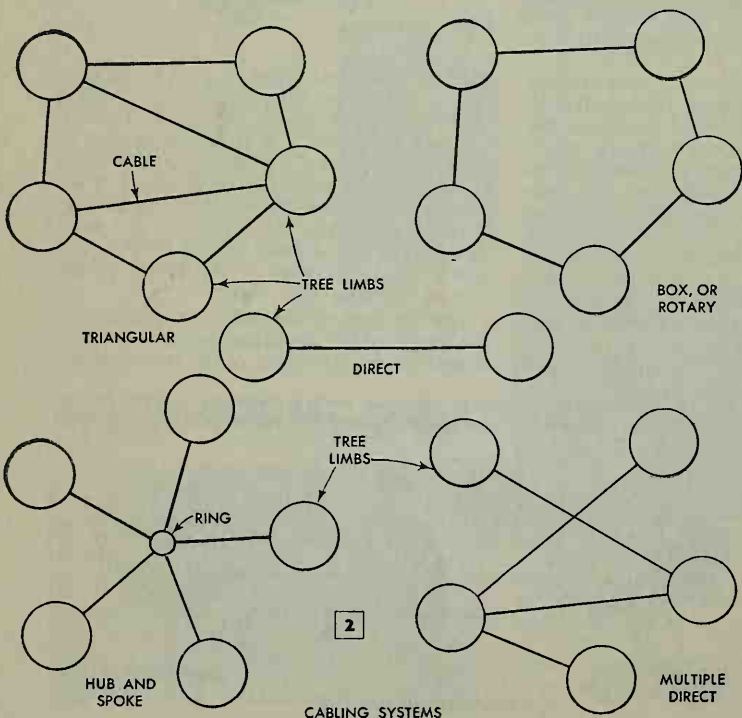
a hole slightly smaller than the diameter of the rod is drilled through both limbs at a point ranging from 18 to 36 in. above the crotch and the rod is turned in until one end projects an inch or so. Then, it is cut off to the required length and the ends coated with a special tree-wound dressing.

In some cases where the limbs are exceptionally large, it will be necessary to countersink diamond-shaped washers, or plates, over both ends of the rod and draw tight with nuts as in the lower left-hand detail in Fig. 5. In making the countersinks use a sharp chisel to produce a clean wound that will heal quickly. Fill the countersinks with tree-wound dressing.

Split trunks and large limbs are sometimes salvaged by use of lip and cross bolts installed across the break as in the upper left-hand details in Fig. 5. Large hollow trunks are frequently braced in this manner before being filled with tree cement. In order to be fully effective, rods used without nuts and washers should turn into at least 4 in. of sound wood in small trees and 6 in. of wood in larger trees. It's a good idea to coat the rods with wound dressing before turning them into place.

In some rare instances it is desirable to bolt two limbs tightly together, or a few

Details below show common methods of cabling and rodding large limbs within the treetop to support a spreading top and prevent crotch breakage. This type of cabling also prevents damage during high winds

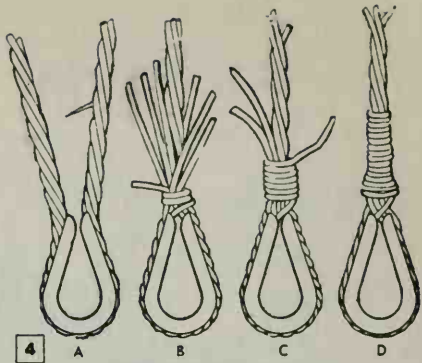


2

3

inches apart, as in the upper right-hand details in Fig. 5. Usually this is done to preserve for a time the form of an old tree. In younger trees one of the interfering limbs should be removed. The limbs should never be forced together and bolted. Only when they are touching at some point is it permissible to insert the bolt without a spacer. In some cases they are separated and bolted together with a spacer between as in the center detail.

Large limbs that rub together during windstorms can be separated by means of the slide arrangement shown in the lower right-hand detail, Fig. 5. A strip or block of hardwood is bolted to one of the limbs, preferably the lower one, and a long U-bolt made from smooth steel rod is fitted into two holes drilled in the upper limb as shown. Thread both ends of the rod before bending, the thread length being slightly greater than the diameter of each limb. After the rod has been bent to the U-shape, run nuts down to the limit of the threads on both ends and place washers over the nuts. Then insert the bolt in the holes and turn nuts onto the projecting ends as shown. It is of the utmost importance to treat all tree wounds immediately to prevent the entrance of insects and disease-producing

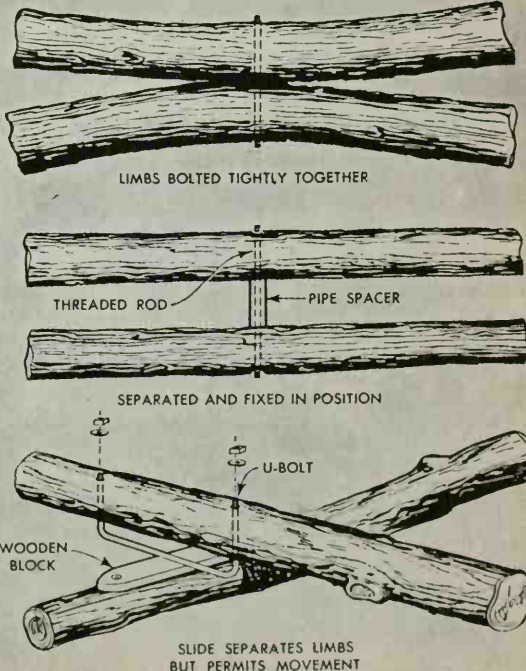
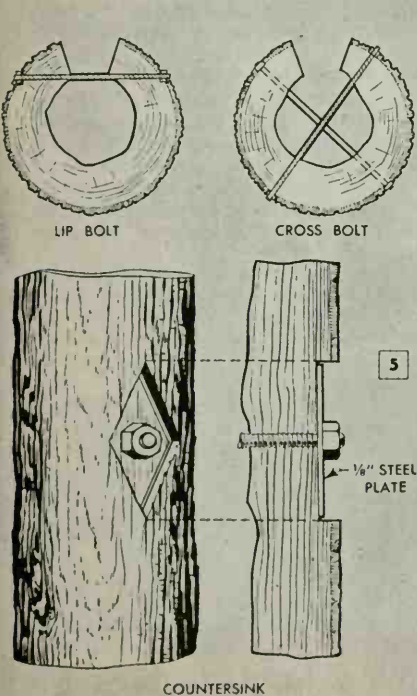


STEPS IN MAKING EYE SPLICE IN 7-WIRE STRAND

Cables anchored to limbs will require an eye splice at each end. Details show how to make a 7-wire splice

organisms. Wounds made by cutting through the bark into the cambium layer must be sealed at once with a special dressing made for the purpose, or with a dressing made by mixing dry bordeaux with raw linseed oil to make a paste sufficiently heavy to stay in place when spread with a putty knife or small trowel. Destroy the unused portion of this mixture. ★ ★ ★

In many instances, split limbs and hollow trunks of older trees are reinforced by lip and cross-bolting as detailed below. Special threaded rods are used for this type of bracing on both old and young trees



SLIDE SEPARATES LIMBS BUT PERMITS MOVEMENT

TREE-FELLING



GOOD TREE-FELLING practices eliminate waste, promote safety and conserve young growth for future cutting. While the basic mechanics of tree felling are quite simple, the technique must be adapted to the job at hand, whether this is a regular lumbering operation in a large forested area, selective cutting of individual trees in the farm wood lot, or the removal of a single defective tree from the suburban lawn or street curb. In big-woods logging operations, the problems of safety and conservation of young growth are first considerations when felling tall conifers and large hardwood trees that have grown to a great height. Often these are surrounded by smaller, underdeveloped trees that must not be damaged in felling the larger tree and removing the log and top. Here professional woodsmen use approved methods and modern equipment to get out the logs. In the farm wood lot where selective cutting is carried out from year to year, each tree marked for cutting is more of an individual problem in felling. Where the growth generally is more open, the tree usually can be dropped intact, and the trunk and top worked up into the desired lengths without interference from buildings, shrubbery, undergrowth or adjacent trees. Urban tree felling often involves the removal of the entire tree, including the stump and a part of the root system below ground, in small, easily handled pieces. This

means that large limbs and the top one third of the trunk must be cut into short lengths and roped down to the ground from a considerable height.

Tools required for most jobs of tree felling are an ax, a two-man crosscut saw, two or three steel wedges and a light sledge hammer or a heavy wooden mallet. Where the work requires pruning and roping limbs down from the top of the tree, you'll need a pruning saw of the heavy pattern and a suitable length of $\frac{3}{4}$ -in. rope. Experienced woodsmen usually prefer a double-bitted ax in a medium weight with a straight handle, and tree surgeons and foresters quite generally use electric or gas-powered chain saws for felling and cutting up the tree. Electric and gas-powered chain saws are available in small sizes suitable for one-man operation. The electrically driven unit is light enough for use in the tree, as well as on the ground.

In felling, the first thing to do is walk around the tree to note the degree of "lean," and the general distribution of limbs in the top. A well-proportioned tree, with an equal distribution of limbs and not more than 2 deg. of lean can be dropped in almost any direction desired, providing this is done on a quiet day when there is little or no wind. If the tree is to be cut in a wood lot where there are other trees and valuable undergrowth near by, estimate the height of the tree so that you know ap-



In urban tree removal, where it is necessary to protect lawns, shrubbery and buildings, large limbs are removed from the tree before felling by swinging them into the clear and then lowering to ground with rope



proximately how far the top will reach in falling. It is well to remember that even the tiptop limbs of a large tree will damage small saplings and strip bark and twigs from standing trees, leaving open wounds which may become infected with various diseases. After you have decided which way the tree should fall, the next step is to make the undercut, Fig. 5. This is made with the ax on that side of the trunk which is in line with the direction you wish the tree to fall. Keep the bottom of the undercut flat and the top at an angle of approx-

imately 45 deg. However, the undercut need not be made square across as shown. It is easier to chop with the ax at a slight angle: The undercut should be finished out at a depth equal to about one eighth to one fourth of the diameter of the trunk and it is important that it be cut down uniformly to a vee all the way across its width. If it is only partially finished at one side or the other, the tree may tend to tilt in that direction when it starts to fall. On the other hand, if the vee is left high at the center, the tree may twist or spiral as it falls.

After undercutting and back cutting at the tree trunk, the limb is lowered without damaging the lawn or curb

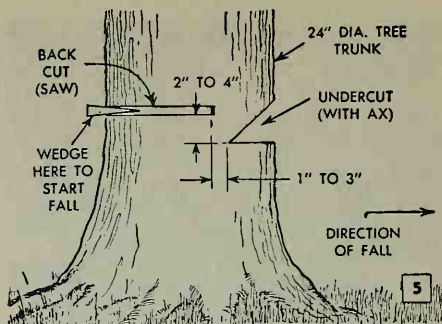




Here's the way a large limb is cradled in a rope sling before being sawed through at the back cut



Above, a Turk's-head knot in end of the rope makes it easier to throw it over a high limb. Below, use a clove hitch when snubbing rope around a tree trunk



Control of the fall depends on how accurately and uniformly the undercut is made.

The back cut is made with the two-man crosscut saw and its height above the ground determines the height of the stump, therefore the undercut and back cut should be as low as is practicable in order to conserve as much as possible of the valuable trunk. On large trees, the back cut can be made to advantage with a chain saw, but on smaller trees the crosscut saw with a narrow blade is best as the narrow width of the blade permits starting the wedges, Fig. 5, before the cut is finished. This is of special advantage when it is necessary to fell a tree against the lean or laterally to it in either direction.

The critical point in felling is reached when the back cut has progressed to a point 1 to 3 in. back of the undercut. This leaves only a narrow cross section of the trunk still holding, Fig. 5. Woodsmen refer to this as the "hinge." At this stage a few light taps on the wedges generally will tilt the tree sufficiently to start the fall, after which the trunk will break at the hinge and the tree will fall free. By skillful use of the wedges woodsmen can make a leaning tree fall to the right or left of the direction of lean or in an opposite direction if the trunk is straight and the lean does not exceed 3 or 4 deg. They do this by making the back cut at an angle with the undercut, the former being cut deeper on the side toward which the tree is leaning. Two wedges are started as soon as the depth of the back cut will permit and they are driven in tightly as the cut progresses. This procedure leaves wood holding on the side opposite the direction of lean and tends to tip the tree in a lateral direction, or, in some cases, "over backwards." Usually the trunk must be broken at the hinge by wedging tightly. It's always best to remove the saw before wedging the tree over. In Fig. 11, the spots marked X generally are considered the safest places to stand while the tree falls. Never stand directly back of a falling tree. Keep a sharp watch for

falling limbs and look out for flying splinters and twigs, especially as the tree strikes the ground.

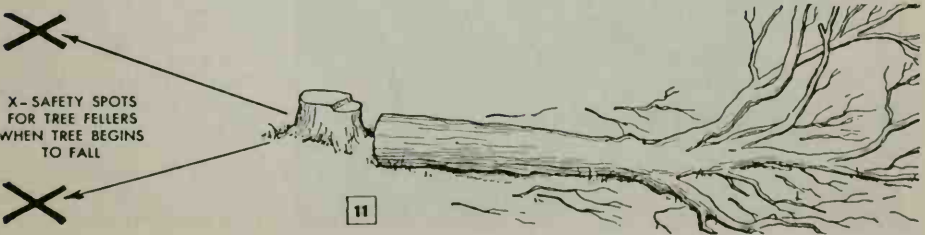
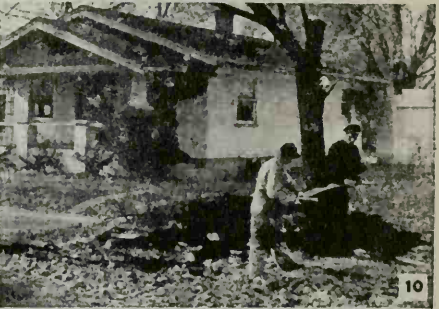
Urban tree removal may or may not involve an ordinary felling problem. Usually on a small lot, the top of the tree overhangs the house or shrubbery and the overhanging limbs will have to be removed by swinging into the clear, or lowered piece by piece to the ground. The process of swinging a large limb and lowering it is pictured in Figs. 1, 2 and 3. First, the rope end is thrown over a near-by limb and the end tied to the one that is to be removed. One man keeps tension on the rope, Fig. 2, while the other saws off the limb as in Fig. 1. Note that an undercut is made on the side of the limb toward which it is to swing and then the back cut is made in the same manner as in felling a tree. When the back cut is nearly through, the limb will swing and finally break, Fig. 4, after which it can be lowered safely to the ground, Fig. 3. By roping in this way it is possible to swing large limbs sidewise so that they can be lowered safely to the ground without damaging shrubbery or any part of the house or garage. One thing to keep in mind when lowering large tree limbs is that the limb will fall butt first if it is allowed to fall free. Tree surgeons often remove large limbs by fixing a tackle block near the top of the tree. They attach the lower end of the tackle to the limb a short distance beyond its center of gravity, then make the undercut on the top of the limb and the back cut from the bottom. A helper on the ground keeps tension on the tackle until the limb is sawed off completely. The limb will swing in toward the tree trunk with the butt down and from this position it is easily lowered to the ground. Where the tree cannot be dropped intact without damaging buildings, lawn or shrubbery, it usually is possible to remove all large limbs by these methods and then fell the trunk without damage. Where the local ordinances call for removal of the stump, cut the trunk 3 to 5 ft. above ground, Fig. 10, and dig away the earth around the stump so that the large brace roots can be cut off as in Figs. 12 and 13. After these roots have been cut, it is comparatively easy



It's a good idea to make a platform of limbs to protect the lawn from being damaged by the falling tree



Above, trimming limbs from one side of a tree often is an aid in felling. Below, if the stump is to be removed, make the back and under cuts 3 to 5 ft. high

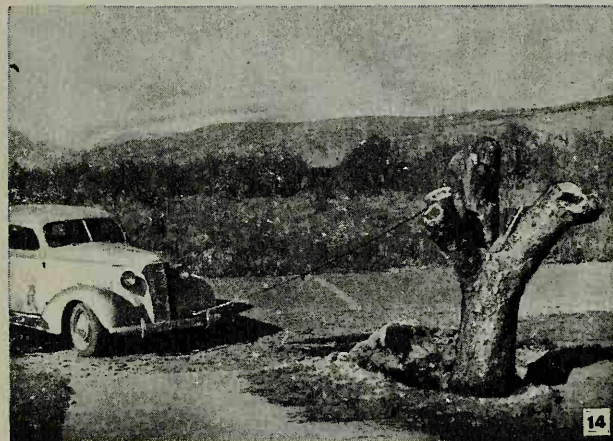




Above, when limbs have been cut off, trunk is easily removed by cutting off brace roots as shown below



After cutting the brace roots, pull out the trunk with a truck or automobile



to remove the stump with a car or small truck as in Fig. 14.

Very often in urban tree removal it is possible to cause a tree to fall just where you want it simply by removing all, or a part, of the large limbs on the side opposite to the direction you want the tree to fall. Fig. 9 shows how this works on a low, spreading tree. The weight of the limbs on one side serves to pull the tree over without wedging or the use of a tackle block. Often it is necessary to protect the lawn or curb from damage by the falling tree and this can be done by making a platform of the limbs and twigs as in Figs. 8, 9 and 10 to break the fall of the trunk and prevent it from gouging into the lawn.

As a rule, the best time to take down a tree by the methods just described is in the late fall or winter after the leaves have fallen and the sap has gone down. The lowered moisture content lightens the wood considerably, and it works easier with axes and saws. Be especially careful when taking down a dead tree or one that has been weakened by disease. Limbs that look sound may break easily; the trunk may be rotted away at the center and may break off without warning before you finish the back cut, permitting the tree to fall out of control. Don't attempt to fell or remove a tree whose limbs overhang or interlace with a power line or telephone wire. Call the local power company or the telephone company. They will have special equipment for handling such a job. Many larger towns and cities have ordinances forbidding the cutting or pruning of trees on the street curbs without special permission from the street department. Don't work in a tree when the bark is wet from rain, or when the limbs are covered with snow, or when the wind is blowing.

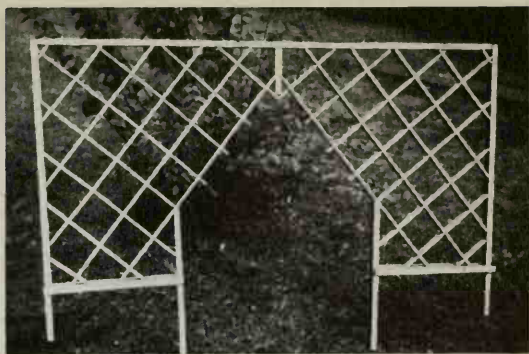
If you have to carry tools into the tree provide them with rope slings so that you always have both hands free when climbing. Take precautions against dropping tools. A rope is easily thrown over a high limb if you tie a Turk's-head knot in the end as in Fig. 6. When anchoring the rope end to another tree, use a clove hitch as in Fig. 7, rather than a conventional knot, which cannot be untied easily if the rope is under tension. Make sure that the rope is in good condition and keep the ends knotted to prevent fraying.

TRELLISES YOU CAN MAKE

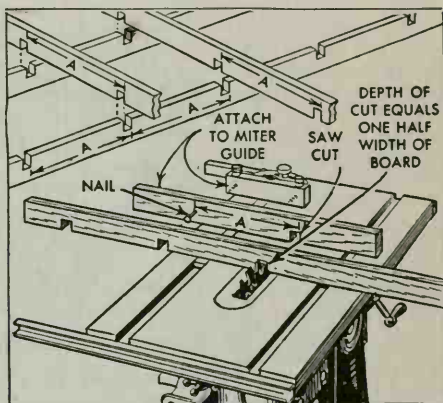
IF CLIMBING plants are to fit into the scheme of your garden, you will by all means need a trellis or two. There are also those fancy types of trellises which are made up of highly intricate designs and are kept free of plants to become ornaments in themselves. However, this latter type of trellis is not too common in the average American garden. Such decorations have little if any practical value in a home garden and often detract from rather than add to the beauty of the home grounds. A good rule to follow in erecting a trellis is to make it subdued rather than striking. A trellis should fulfill its function as an accompaniment and aid the desirable vegetation.

The basic form of trellis work consists of narrow strips of wood nailed in vertical and horizontal positions on a framework of heavier wood. The spaces between the parallel laths are usually equal to the strips themselves. Here is where your originality can be used to get away from the monotony of this basic design. You can make use of such ordinary things as clothes hangers, wagon wheels and even an old porch gate to construct interesting and useful trellises. Explanations as to how this can be done are included on the next page.

The basic crisscross pattern is used with certain variations in the trellis shown in the upper right-hand corner of this page. This trellis is easy to make with half-lapped joints if the miter-guide jig which appears in the detail is used to space the notches uniformly. The notches preferably are made with a dado saw, but they also can be cut with an ordinary saw blade. The notches, of course, must be the same width as the thickness of the stock and as deep as one half its width. Standard lattice stock is used for the grillwork of the trellis which, when assembled is framed with 1 x 2-in. pieces. First, notch a short length of stock and drive a nail into it as indicated, distance A being equal to the distance the notches are to be spaced. Then screw this strip to the miter guide on the saw table. To cut the notches with a dado saw, make the first one near the end of the strip, and using the jig with the nail as a stop pin, proceed to cut each succeeding notch. Approximately the same method is used with a saw blade, except that the notches are made by holding one side of the preceding notch against the nail and making repeated cuts until the other side of the notch contacts the nail. By adjusting the miter guide,



The trellis above is a variation in the ordinary crisscross pattern. The detail below shows specifically how it is made



Here is a portable trellis which can be moved easily to meet the shade or sun requirements of a plant



Coat hangers can be put to good use to make a trellis

angle cuts also can be made in this way to obtain a diamond-shaped pattern. After notching the strips, cut them to length and assemble the trellis with brads in the usual manner by driving them through the center of the half-lapped joints. Before nailing each joint, apply white lead to the meeting faces to prevent dry rot. The trellis is supported by two center stakes, the ends of which are preserved by dipping in creosote.

A very convenient kind of a trellis to have in your garden is a portable one, like the one in the lower right-hand corner of the preceding page. This trellis can be moved easily to meet the sun or shade requirements of any particular plant. If you wish to grow a certain ivy or climbing rose which must have shade, it's a simple matter to set up the trellis in a shaded spot and vice versa for plants requiring sun. The trellis is made by casting concrete blocks around pipe sockets in which the uprights are inserted. If cylindrical-shaped concrete blocks are used, they may be rolled from place to place in the yard.

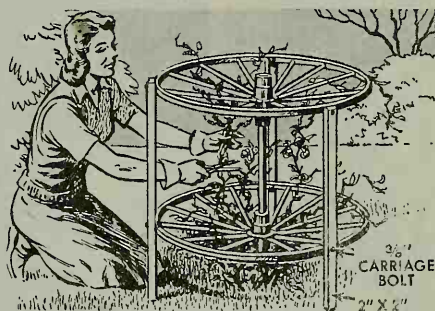
Now let's discuss those trellises that can be made from coat hangers, wagon wheels and an old porch gate. A trellis made of ordinary wooden coat hangers is about the simplest kind you can make. For half the job is already done before you have even lifted a finger. All you have to do is nail the coat hangers across three uprights of

lath or lattice stock, give the trellis two coats of paint and, when dry, embed the ends of the uprights in the ground.

If you happen to have a couple of old wagon wheels available, you can make good use of them in the construction of a trellis. The wheels are merely mounted horizontally, one on top of the other, supported with three 2 x 2-in. stakes spaced evenly around the edges, attaching the wheels to the stakes with $\frac{3}{8}$ -in. carriage bolts.

That old porch gate that has been lying around may also come in handy to provide an attractive flower trellis. The gate is extended to the desired height and attached with screws to a post or the side of a building so it is easily removed. If set up against a building, use wooden spacers to hold it away from the siding. The wonderful thing about this trellis is that it can be folded and stored away during the winter.

There are probably numerous other objects around the home that can be converted into a trellis. You do not have to be a master craftsman to work on such a project. Just look around and see if there are any odd pieces that can be converted into a trellis. Let your imagination have a free rein. You might be surprised at the results.



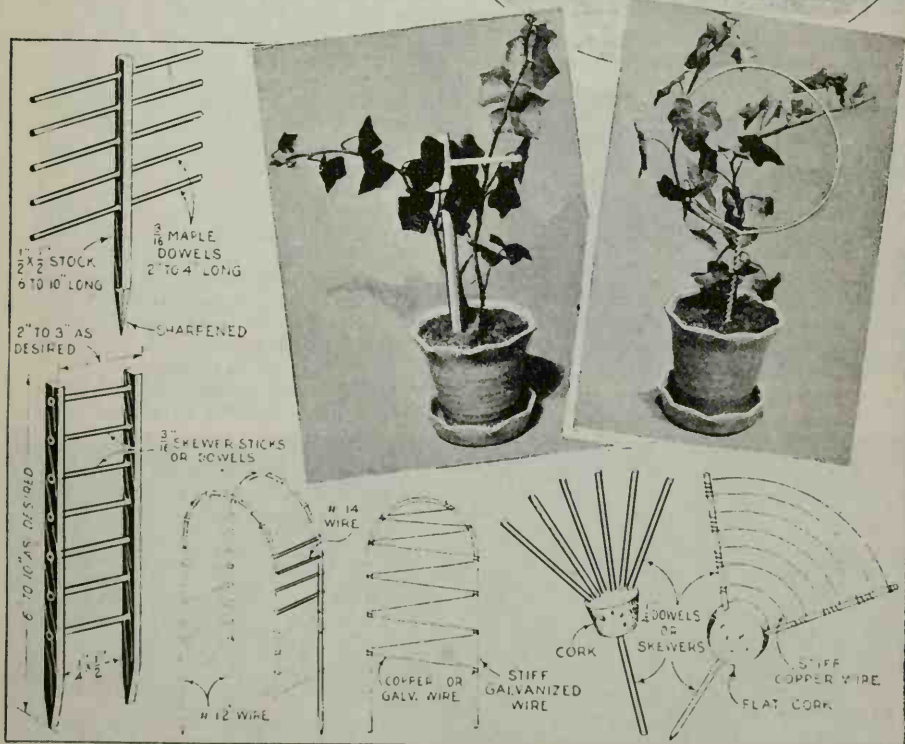
A trellis can also be made by mounting wagon wheels

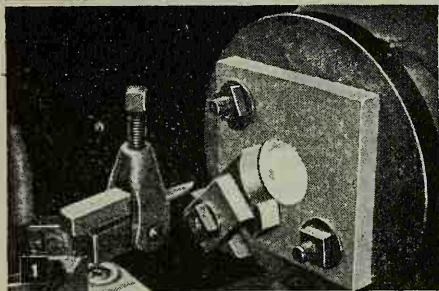


An old garden gate was used to make the trellis above

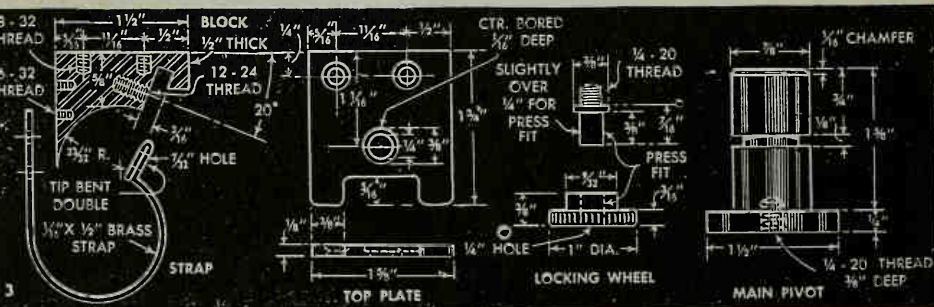
Tom-Thumb. **TRELLISES**
improve indoor gardens.

THESE tiny trellises add the atmosphere of an outdoor garden to groups of potted plants kept indoors during the winter months. Wire, a few large corks, small dowels or skewers and several strips of pine are all the materials you need to make up the ones shown below. In any case they should not be too large but should be kept in proportion to the size of the pots and plants. Although trellises usually look best painted white, other colors or combinations may be used.



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The tilting head consists of a saddle block and a brass binding strap that rides

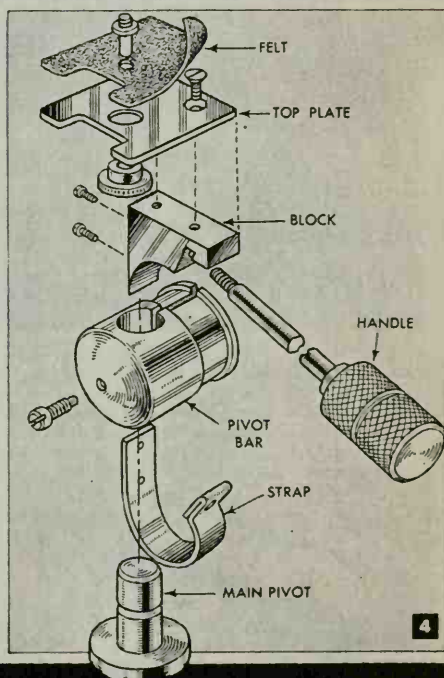


TRIPOD HEAD

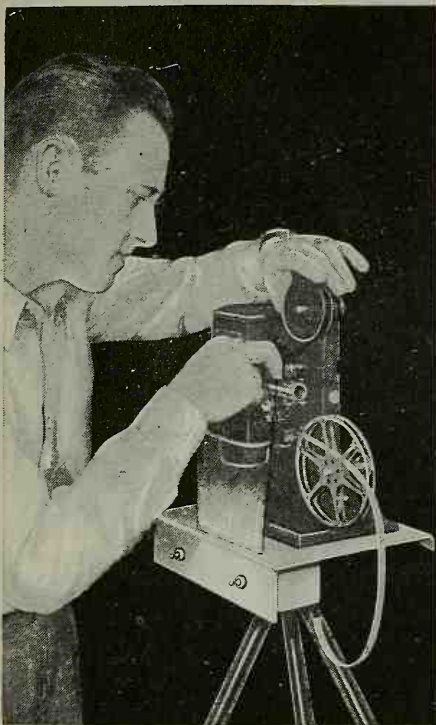
This tripod head is sturdy enough to support a large view camera. A single locking device controls both pan and tilting movements without any other adjustment

in the crossbar step and serves as a clamp. The block is machined from $\frac{1}{2}$ -in. brass, the arc being cut on the same radius as that of the $\frac{1}{2}$ -in.-wide step cut on the crossbar. Fig. 1 shows the setup for cutting the arc. After the arc has been cut, the block is grooved as in Fig. 3 to take the bent end of the binding strap. The shouldered end of the locking handle, Fig. 3, passes through the strap and turns into a threaded hole drilled and tapped in the saddle at a 20-deg. angle. Two 6-32 fillister-head machine screws, turning into holes drilled and tapped into the back face of the saddle block, hold the flat end of the binding strap. The locking handle, which is threaded to fit the 12-24 tapped hole, is used to hold the strap in position while it is bent to shape. Holes are marked while the strap is held tightly in position and then are drilled and tapped for short screws. The handle is in "release" position to allow for proper tightening of the strap.

A brass top plate is fastened to the saddle block with two flat-headed cap screws. Note that the plate is counterbored for the flanged spindle of the locking wheel, Figs. 3 and 4, and that the spindle is machined for a press fit in the wheel hub. Glue a piece of felt to the top of the plate. Although a machine finish is attractive, some builders may wish to grind and polish exposed parts of the unit. The handle, pivot bar and the main pivot can be ground smooth in the lathe and then polished on a buffing wheel. Flat surfaces are polished by rubbing on a piece of crocus cloth tacked to a flat block of wood.



TRIPOD PROJECTOR BASE

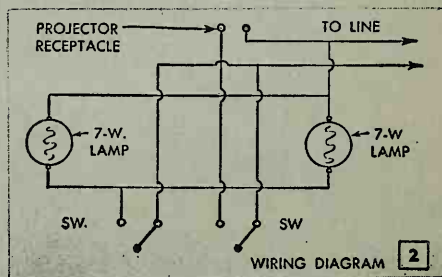
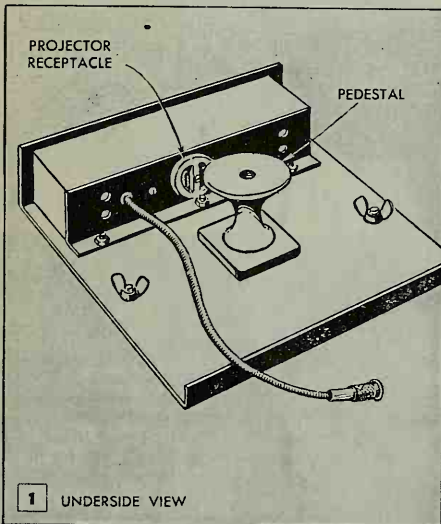


If home movies are your hobby, a sturdy tripod projector base is practically indispensable when it comes to presenting a smooth-running show to your friends

AN INVALUABLE accessory for your home-movie equipment, this projector base has two outstanding features. One permits the projector to be set up on any camera tripod, either wooden or metal, thus eliminating the bothersome job of setting up a table each time you wish to show movies. The other feature is a built-in utility light which provides sufficient indirect illumination for threading the projector and examining the film without turning on the room lights. Two switches, conveniently located on the side of the base, allow both the projector and the utility light to be turned on and off independently. The unit is compact and can even be stored in the back of some projector cases.

The base detailed in Fig. 3 was built for a specific projector and, of course, the dimensions may be varied to suit the particular requirements of your outfit. For rigidity, make the base from 16-ga. sheet metal, using 24-ga. metal for the lamp housing. The projector clamps are of sheet metal and are fastened to the base with wing nuts. These clamps are faced with felt so they will not mar the finish of the projector. Cut a $\frac{1}{2} \times 5$ -in. slot in the base directly over the lamp housing, making sure it will clear the edge of the projector when the latter is clamped in place. The slot can be made by first marking its length and width on the base and then drilling a hole at each end. The waste is removed with a hacksaw blade or a pair of duckbill tinner's snips. To diffuse the light, cover the underside of the slot with a piece of ground glass held

Projector base has two toggle switches. One controls light which illuminates the film gate and tracking mechanism. The other controls projector operation. Tripod permits setting projector at suitable height



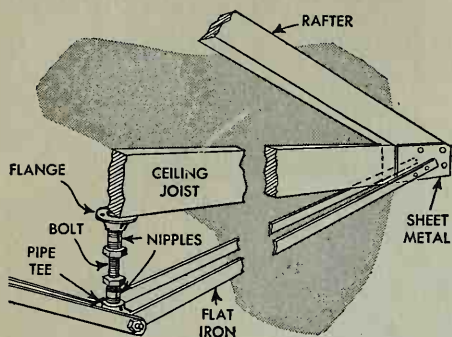
The pedestal, which raises the base 2 in., is required only if the base is to be mounted on a wooden tripod, as the head of this type of tripod usually is too large to provide clearance for the lamp housing. The pedestal is merely a turned metal extension fitted with a threaded stud in one end and tapped for the tripod screw in the other. Although the over-all dimensions of the original pedestal are given in Fig. 3, they are not critical. In addition to its intended use, the pedestal also will come in

The extension cord, which connects the lamp housing to the 110-volt line, is connected by means of a plug and jack to a short cord which runs from the housing. This arrangement allows the longer cord to be rolled separately for carrying. For a neat appearance, the base can be chrome-plated or given a wrinkle finish.



TRUSSES

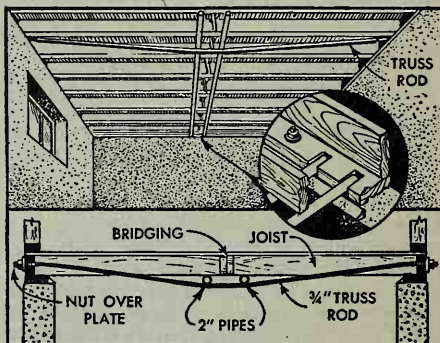
Adjustable Truss for Garage Ceiling Joist Prevents Buckling Walls



The walls of a hip or gable-roofed garage or small barn can be kept from buckling by installing one or more ceiling joists and fastening this flat-iron truss under each joist. Also, with these trusses in place the space between the joists and rafters may be used for storage without danger of sagging the joists and bulging the side walls inward. The truss consists of four lengths of flat iron, two of which are bolted to the joist and rafter at each plate. These points are reinforced with pieces of sheet metal. At the center of the rafter, the flat-iron strips are bolted to a tension adjustment which is assembled from pipe fittings and a bolt with double nuts, as shown.

Truss Rod Supports Floor to Eliminate Post in Basement Recreation Room

If a basement post makes the space useless for a recreation room, the post can be removed and the floor braced with two lengths of pipe and a truss rod. Two lengths of 2-in. pipe are placed parallel from wall to wall across the joists. Notches are made in the sills to take the ends of the pipe. Then a $\frac{3}{4}$ -in. truss rod, placed parallel to the joists at the center of the room, is inserted through holes drilled in the boxing. Steel plates and nuts over each end of the rod are used to draw it tight from the outside of the house. If the room is more than 16 ft. long, it is advisable to use two truss rods to provide sufficient support.



Save Time in Making Roof Truss By Using This Type of Form

With this simple form you can save one-third to one-half the time usually required to construct roof trusses and be assured that all trusses will be exact duplicates, thus avoiding any sags or humps in the roof. To make the form, first make up a platform of boards or planks on a flat surface. Then assemble one half of a truss and nail it securely to the platform. Next, nail 2 by 4-in. blocks to the platform on each side of the heavier timbers of the truss, and nail 1 by 4-in. blocks on each side of the braces as indicated. These blocks now serve as a guide or form in laying the timbers and braces for all succeeding trusses. After completing one half of a truss, it is removed from the form and the other half is completed.



TUCK POINTING

It's important to keep mortar joints between bricks water-tight to avoid costly repairs

WHETHER your home is of brick or of frame construction with only a brick chimney, you no doubt realize the necessity for tuck pointing; that is, renewing the loose and crumbling mortar in the joints between the bricks. This is one phase of home-repair work in which you can save a sizable amount of money by doing the job yourself, and it does not require any special skill or know-how.

The primary cause of the loosening of the mortar is the entrance of water into hair-line cracks where the bricks have pulled away from the mortar. Constant wetting, especially during the spring and fall, weakens the mortar and, during the winter, the freezing of water in the cracks causes the mortar to crumble. The result, of course, is further deterioration and, if not corrected, results in a dangerous weakening of the structure. All brick surfaces are subject to mortar erosion, but the problem is most likely to be encountered in the chimney brickwork, Fig. 1, and on the walls under parapet copings, leaky eaves troughs and large windows, as well as at any point where brickwork comes in contact with moist earth. Stopping water leakage at its source may require only calking of the

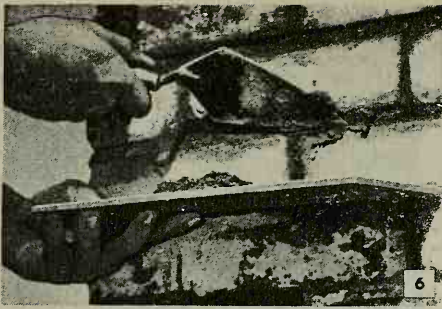


Chimneys frequently need tuck pointing as their location subjects them to all damaging weather elements



Above, before chimney is tuck pointed, the cap is examined and all cracks are sealed to keep out water. Below, remove all loose and crumbling mortar, brush away the dirt and saturate the brickwork thoroughly





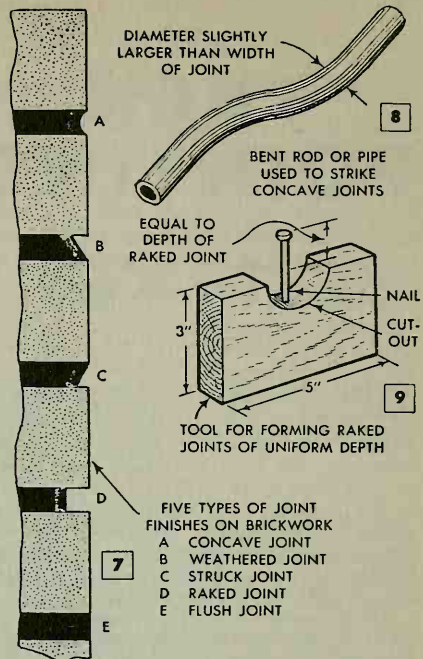
Edge of pointing trowel is pressed over mortar to "strike" the joints, making them compact and smooth

crack through which it is entering. Sometimes this can be done with an application of roofing cement as in Fig. 2. However, occasionally it is necessary to replace a flashing, repair a cracked chimney cap or renew a wall coping.

Danger sign: A white frostlike deposit on the outside of the brickwork is an obvious indication that water is penetrating the mortar joints. The deposit, called efflorescence, is caused by soluble salts being washed out of the bricks and mortar, and can be removed by scrubbing the affected surfaces with a solution of muriatic acid, 1 part, and water, 10 parts, using a fiber brush to apply the solution. All traces of the acid should be rinsed from the brickwork with a garden hose. *Caution: Avoid getting the acid solution on the skin or the clothing. Wear rubber gloves while working.*

Cleaning and soaking: Before tuck pointing, remove all loose mortar with a cold chisel or with a screwdriver and hammer, Fig. 3. Avoid chipping out solid mortar but remove that which can be pried out by hand or with only light tapping. Then brush the dirt and dust away as in Fig. 4. Dry bricks quickly absorb moisture from fresh mortar, causing the mortar to congeal and preventing proper adhesion. To avoid this, thoroughly wet the brickwork before the mortar is applied, Fig. 5.

The mortar mix: Bags of prepared mortar can be obtained from most building-supply stores. Dry-mix the entire bag to be sure that the ingredients are uniformly distributed. Then put a small amount (as much as you will use in about an hour) in an old metal pail and, adding water a little at a time, mix thoroughly until the consistency is quite stiff. If you prefer, you can make your own mortar by mixing portland cement, 1 part, hydrated lime, 1 part, and clean, sharp sand, 6 parts—all measured by volume. For extra-strong mortar, use 3 parts of sand instead of 6 parts. Use the mixed mortar as soon as possible, as it

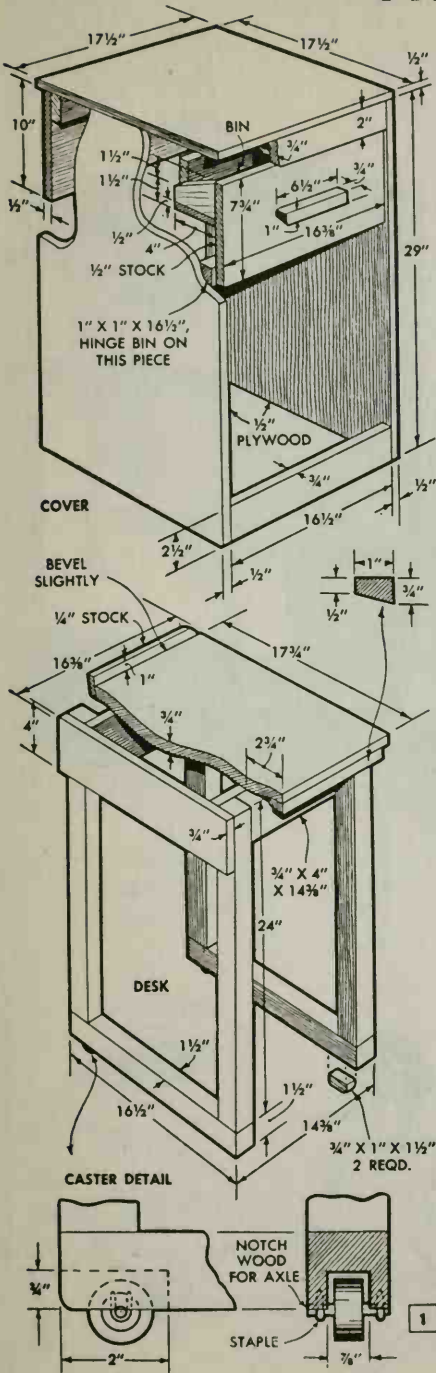


quickly becomes too stiff to work and will lose some of its strength each time it becomes necessary to add water. If you use a wooden mixing board, soak the board with water so it will not absorb moisture.

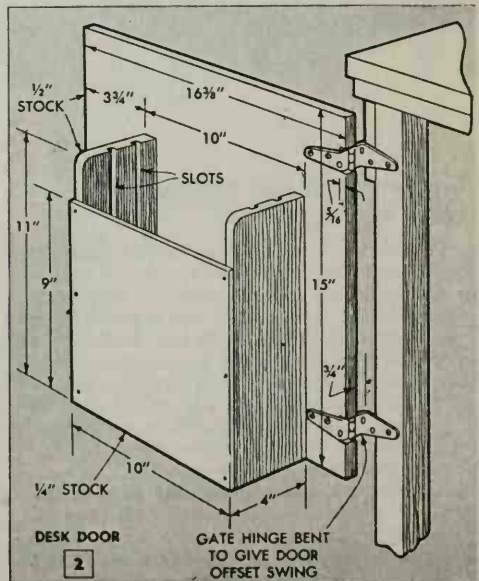
Applying the mortar: The only tools needed for filling the joints with mortar are a pointing trowel and a 6 x 12-in. hawk for holding the mortar, the latter being cut from sheet metal or hardboard. With the hawk, hold a small amount of mortar alongside a horizontal joint and work it in place with the trowel, Fig. 6. Try to avoid smearing the face of the bricks. After a few of the joints have been filled and before the mortar sets, finish them by pressing the trowel or other tool against the joints and drawing it across the surface of the mortar. This is called "striking" and is done vertically first, then horizontally.

Kinds of joint finishes: Fig. 7 shows a number of joint finishes commonly used. Concave joints, detail A, are usually considered the best since the mortar in them is packed tightly against both sides of the joint. They are easily made with a round-edged tool like the one pictured in Fig. 8. If the raked joint, detail D, is the one you must match, use a tool such as the one shown in Fig. 9. After recessing the joint with the raking tool, compact the mortar with a flat tool.

TYPEWRITER HIDEAWAY

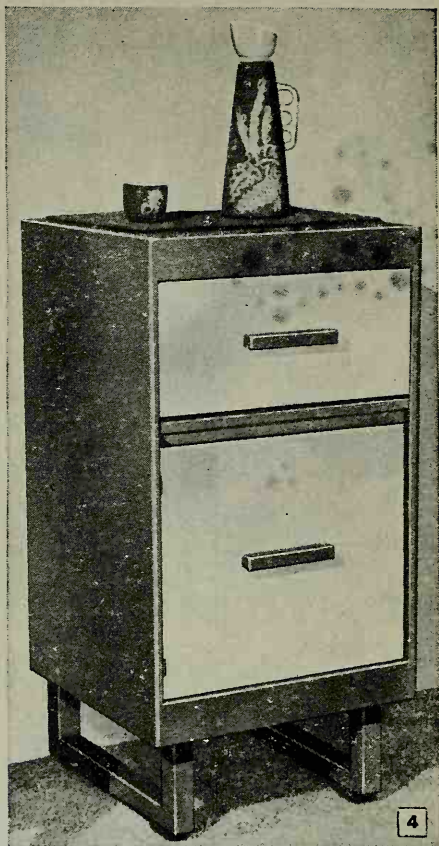


THIS UNUSUAL two-piece cabinet is styled to fit in with modern room decor and to house the home business office with its typewriter, stationery and records in the minimum of floor space. The typewriter is mounted on a stand in ready-to-use position, Fig. 3. By placing the removable cabinet, or cover, over the typewriter stand, you get the neat, occasional piece pictured in Fig. 4. To fit the cover over the typewriter, approach the table from the front. Then lift the cover and slide it past the table, lowering it to rest on the ledge of the stand. When the parts are separated the cabinet serves as a roomy single-pedestal desk provided with a tilting tray, or bin, for pencils, erasers and other small accessories. Note in the details, Fig. 1, that the typewriter stand is provided with two rolling casters of the stationary type mortised into the horizontal tie member under the rear legs. When the unit is assembled, it may be moved about easily by simply grasping the lip extension under the tray. Small hardwood skid blocks are attached to the tie members under the front legs so that the stand is level when at rest. The top and sides of the cover, Fig. 4, are made of plywood. Fir plywood is inexpensive but is somewhat more difficult to finish. Plywoods faced with gumwood, birch, or oak are more suitable for both the painted and natural-wood finishes. If the better grades of plywood are used, make the stand from a



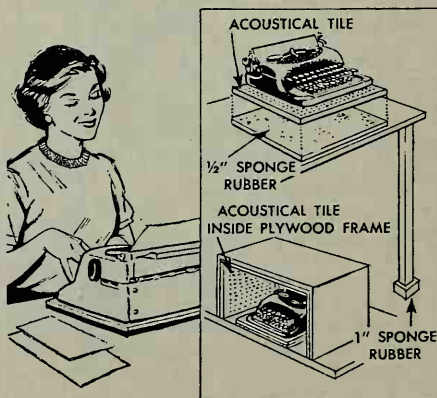


matching hardwood. Assembly of the stand is made with glue and flat-headed screws, as all joints are invisible when the cover is in place. Exposed joints of the cover can be glued and bradded, or fastened with screws turned into countersunk holes which are then filled with hardwood screw-hole buttons. Note that the ends of the stationery compartment, Fig. 2, are grooved, or slotted, for plywood dividers. The door swings on special offset hinges made by bending ordinary strap, or gate, hinges to an S-shape and mortising the door so that the hinge joints fit flush. The drawer and door handles are handmade.



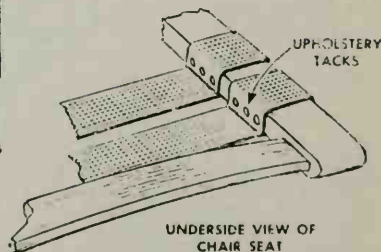
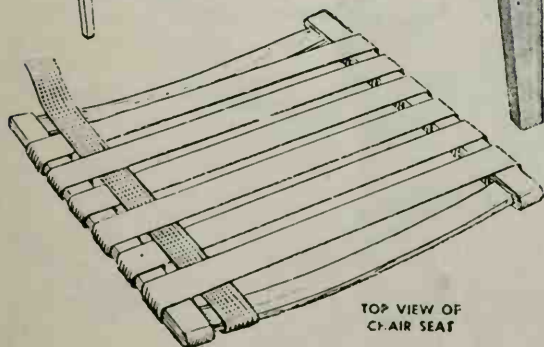
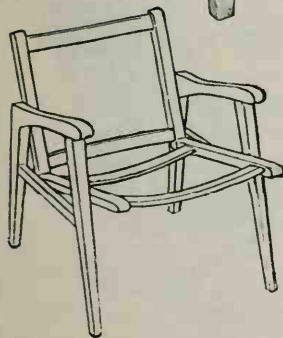
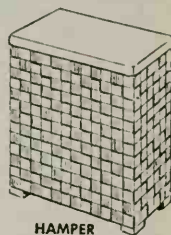
Typewriter Noise Reduced With Acoustical Tile

Other members of your family will not be annoyed by the noise of a typewriter if you take some simple steps to silence it. Since the table on which the typewriter is set acts as a sounding board, isolate the machine from it as much as possible. To do this, place a layer of sponge rubber on the table with an acoustical tile on top of it. A typewriter placed on top of these two sound deadeners is silenced considerably. The deadening effect can be increased by putting sponge rubber under the legs of the table. Further silencing can be effected by building a box, as shown, to cover three sides and the top of the machine, and lining this box with acoustical tile.



UPHOLSTERING WITH PLASTIC WEBBING

Reupholstering becomes so simple with a new woven plastic webbing that anyone can put new life back into old furniture. The webbing also provides home-workshop fans with a new crafting material which has unlimited uses



UPHOLSTERY TACKS



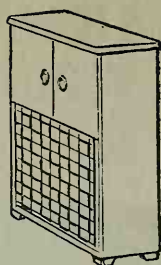
COFFEE
TABLE

DOES YOUR ATTIC harbor a furniture derelict—a shabby upholstered chair, perhaps, that has been cast aside for want of a new seat? Look what you can do with a new material, called plastic webbing, to bring these forgotten pieces back to life. A common pull-up chair, for example, can be transformed into a smart modern piece and, what's more, it is such an easy job that anyone can qualify. "Reupholstering" with plastic webbing is simplified to the point of interlacing the strips, drawing them taut and tacking the ends securely to the chair frame. Available in 150-ft. rolls, 2 in. wide, the webbing may be purchased by the foot and can be had in many different colors at leading department, hardware or upholstery-supply stores. It is strong and sagless, moisture and fade-resistant and cleans like new with soap and water.

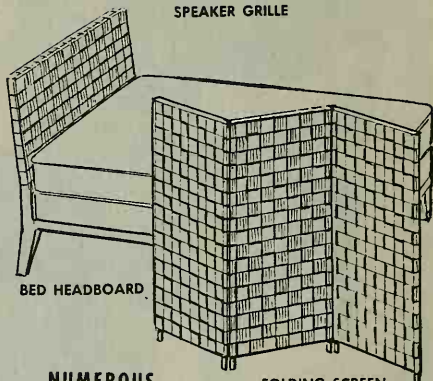
By means of special metal fasteners, it's a simple trick to apply plastic webbing to tubular furniture. Here, holes are drilled at intervals through the inner wall of the metal frame to take studs on the fasteners which are designed to snap in the holes and draw the webbing taut. The details given below and on the facing page show how the webbing is applied.

The use of plastic webbing is by no means limited to reupholstering chairs. The clever home craftsman can use it to add a smart basket-weave treatment to the face of cabinet doors and speaker grilles, to cover bed headboards, clothes hampers, valance boards and folding screens, as well as tops of coffee tables and benches. ★ ★ ★

Information courtesy Martin Fabrics Corp.



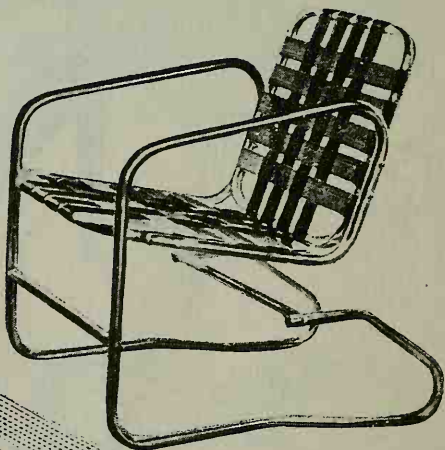
SPEAKER GRILLE



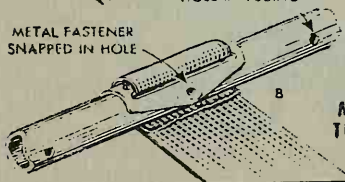
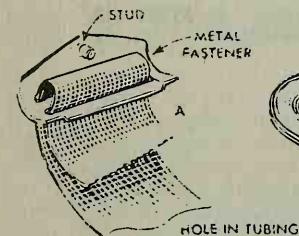
BED HEADBOARD

FOLDING SCREEN

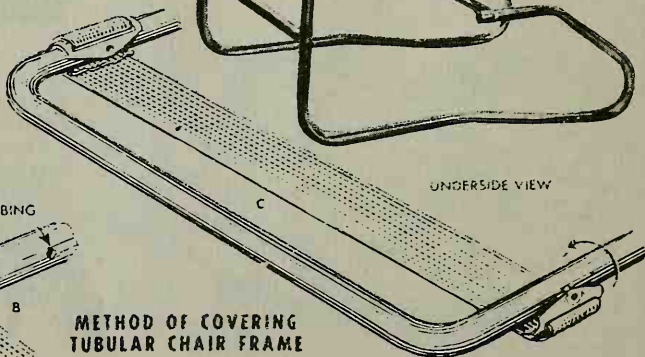
NUMEROUS
APPLICATIONS



UNDERSIDE VIEW



METHOD OF COVERING
TUBULAR CHAIR FRAME



FOAM RUBBER

Simplifies Upholstering

Have you a piece of furniture that needs upholstering but are afraid to tackle the job yourself? Foam rubber and sagless-type springs now make upholstering at home easy



STRIPPING a sagging, overstuffed chair down to the frame is easy for anyone but building it back up again is a job not many care to undertake. The task of tying countless springs together and the work of adding cotton and hair padding are complicated steps that make upholstering difficult for the novice to master.

However, what was once a trying job is now actually fun. New sagless-type springs, which are merely hooked to the frame with special clips, do away with tedious tying, and resilient foam rubber, which is cemented in position, takes the place of padding without the drawbacks of matting and shifting.

On this and the following seven pages, John Bergen, in cooperation with the U. S. Rubber Co. and the No-Sag Spring Co., shows how simple it is to upholster both old and new furniture using these two new products. Full-size plans, plus material lists, are available for constructing the frames for the new pieces of furniture which are pictured on the first three pages.

This new-type spring is sold under the trade names of No-Sag and Zigger Wire and is manufactured in strip form from spring-steel wire which is bent in a zigzag pattern. The wire does not actually become a spring until it is uncoiled and stretched and anchored at each end to the seat or back frame. Sagless-type springs are sold both in ready-cut lengths and in coils up to 160 ft. long. Springs of No. 8 to 11-ga. wire are recommended for seats, while springs from No. 10½ to 12½ ga. are best for backs.

Measuring springs for length: The comfort and resiliency of sagless-type springs will depend entirely on the correct arc, gauge of the wire and length of the springs. The greater the arc, the more resilient the seat. Never make the arc greater than 2 in. high without using a hinge link, which is a U-shape wire connector applied to the end of the spring at the back seat rail. To measure sagless-type springs for length, hold one end of the uncoiled spring on one end of a yardstick. Then roll back the

**TABLE OF GAUGES AND SIZES
OF SAGLESS-TYPE SPRINGS FOR SEATS**

Inside-Seat Dimension	Gauge	1 1/4" Arc	1 1/2" Arc	1 3/4" Arc	2" Arc
12"	11	1 13/4"	12"	12 1/2"	
13"	11	1 13/4"	13"	13 1/2"	
14"	10 1/2	1 3/4"	14"	14 1/2"	
15"	10 1/2	1 4/4"	15"	15 1/4"	
16"	10	1 5/2"	16"	16 1/4"	
17"	10	1 7/2"	17"	17 1/2"	
18"	9 1/2	1 8/4"	18"	18 3/4"	
19"	9 1/2	1 9/4"	19"	19 3/4"	
20"	9	20"	20 1/2"	20 3/4"	20"
21"	9	20"	20 1/2"	20 3/4"	21"
22"	8 1/2	21"	21 1/4"	21 3/4"	22"
23"	8 1/2	22"	22 1/2"	22 3/4"	23"
24"	8 1/2	23"	23 1/4"	23 3/2"	24"
25"	8	24"	24 1/4"	24 1/2"	25"
26"	8	25"	25 1/4"	25 1/2"	26"
27"	8	26"	26 1/4"	26 1/2"	27"

Inside-seat dimension is the distance between the inside of the front and back rails. Sagless springs cut to this exact length will give you the normal arc. It varies from 1 1/4" to 2" increasing with the length of the spring as shown above. When clip is not attached to inside edges of frame, clip-to-clip dimensions can be used instead of inside dimensions.

other end of the spring until it lies flat on the yardstick. The distance between the extreme outside edges of the bent ends is the correct length of the spring. Avoid measuring with a flexible-steel tape around the curve shape of the spring as this will give an incorrect measurement. Springs that are sold already cut are measured by the yardstick method.

Cutting and bending ends of springs: When the spring wire is purchased in coils, it must be cut into individual springs of the proper length, after which the ends must be bent back slightly. The wire can be cut either with a file or fine-tooth hacksaw blade. With a file, a notch is made in the wire while it is clamped in a vise and then the wire is bent back sharply to snap it off. Bending back of the ends is done

by clamping the spring in a vise and hammering the end back. Bending the ends back is necessary to prevent the springs from slipping out of the clips which are used to anchor them to the wooden frame. When the springs are purchased ready-cut to length, they come with the ends already bent.

How springs are installed: The special metal clips which hold the spring ends securely to the frame are nailed in place first. The chart given on page 162 recommends the number of springs needed in the seats and backs of certain size frames and also gives the correct spacing of the clips. Mark the location of the clips on the rails of the frame. When the seat tapers to the back, the outside clips on the back rail should be placed the same distance in from the sides as they are placed at the front. The other clips for the back seat rail are spaced evenly between the outside clips. On large seats, the second clip from the outside on the back seat rail is spaced evenly between the outside clip and the normal position of the third clip. The springs are always installed between the front and the back seat rails in the case of the seat, and from the top rail to the back liner when springing the back of a chair. The only exception is when the seat and the back are upholstered together in one continuous form. Then the springs are installed between the side seat rails and between the back posts.

When nailing the clips in place, be sure each clip overhangs the inside edge of the frame at least 1/8 in. This allows the spring to swivel freely inside the clip and prevents noise that might otherwise result from restricted spring movement. It is best to install all clips in their respective positions with one nail before hooking the springs in place. In placing the springs, it is important to alternate the direction of

**TABLE FOR DETERMINING
NUMBER OF SAGLESS STRANDS, PROPER
SPACING OF CLIPS AND CORRECT SIZE OF SEAT
HELICALS, EXTENSION SPRINGS FOR CHAIR AND SOFA SEATS**

Distance Between Arms Along Front Rail	Number of Sagless Strand	Center- to-Center Spacing for Clips	Center Spacing of Two Outside Clips From Inside Arm Posts	Seat, Helical and Extension Spring Size
21" Chair	5	4 1/4"	2"	2"
22" Chair	5	4 1/2"	2"	2"
23" Chair	5	4 3/4"	2"	3"
24" Chair	5	5"	2"	3"
24" Chair	6	4"	2"	2"
25" Chair	6	4 1/4"	1 7/8"	2"
58" Sofa	12	5"	1 1/2"	3"
59" Sofa	12	5"	2"	3"
60" Sofa	13	4 3/4"	1 1/2"	3"
61" Sofa	13	4 3/4"	2"	3"
62" Sofa	13	4 3/4"	2 1/2"	3"
63" Sofa	13	5"	1 1/2"	3"
63" Sofa	14	4 1/2"	2 1/4"	2"
64" Sofa	14	4 1/2"	2 3/4"	2"
65" Sofa	14	4 3/4"	1 5/8"	3"
66" Sofa	14	4 3/4"	2 1/8"	3"
67" Sofa	15	4 1/2"	2"	2"

Where distance between arms is in half inches use table for next smaller or larger size and set each outside clip 1/4" farther away from arm post (if table for smaller size is used) or 1/4" closer to arm post (if table for larger size is used).

Sagless-type springs are installed in back by nailing lower clips closed and drawing springs upward



First step is to nail spring clips to frame. Note wire hinge links along back rail. Links plus clips are used at rear rail when greater spring arc is desired



the bent ends. For example, if the bent end of the first spring points to the right, the bent end of the adjacent spring should point to the left. Alternating the direction of the bent ends of the springs brings closed loops opposite each other, thus permitting helical and retainer springs to be applied to the sagless-type springs in a straight line. Alternating the bent ends of the springs also is necessary to permit installing edge springs.

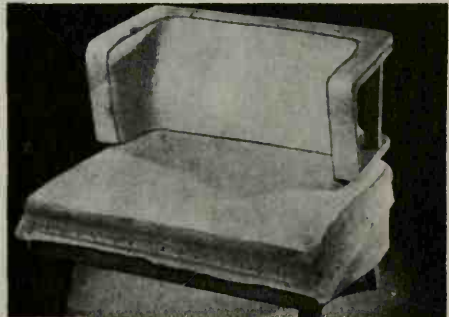
Installing springs in seat: When all the clips have been nailed to the frame, you are ready to install the springs. To determine the gauge and length of the springs needed for the particular frame at hand,

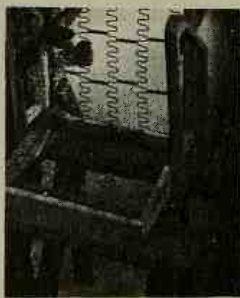
measure the frame from the inside of the front rail to the inside of the back rail. Then consult the chart on page 163 to find the length and the gauge of the springs needed. Keep the arc about 2 in. high. This will make the most resilient seat.

Each spring is installed individually by first hooking it in the open clip at the back seat rail and then nailing the clip shut. After this the spring is pulled forward, hooked in the clip at the front rail and the clip is nailed shut as before. As sagless-type springs are quite stiff and thus require a good deal of pull to stretch them, you should make sure that the clips are well nailed and that you have a good hold

Next, the springs are covered with burlap. Long running stitches are used in sewing it to the springs

Tacking strips of muslin, cemented to edges of foam-rubber pad, serve to secure rubber in place on seat





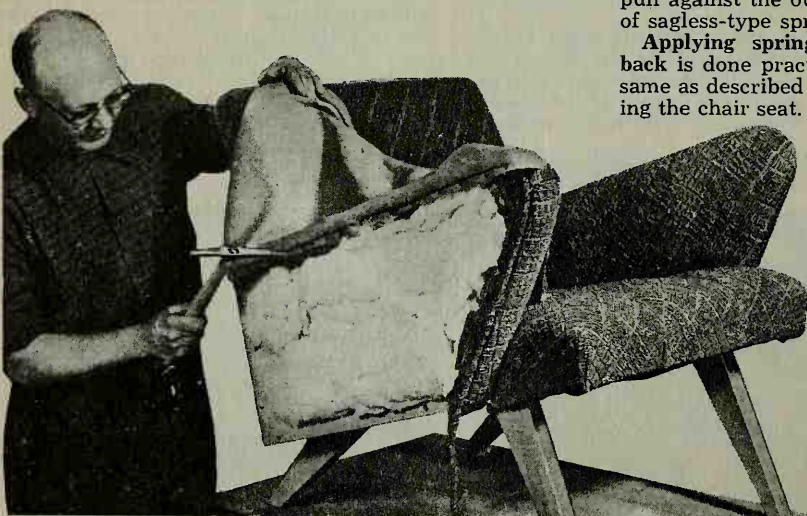
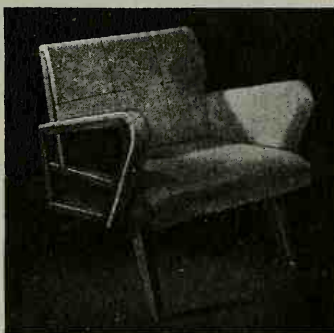
Above, small helical springs tie sagless-type springs together crosswise in both seat and back. Below, foam rubber, covering arms of chair, is cemented at seams



Above, chair arms are covered on inside with furniture webbing. Back and seat have already been covered with burlap. Below, photo shows chair padded with foam rubber and ready for fabric cover. Cotton is used to pad arms on outside



Below, fabric cover is applied to outside face of arms last. First, welting is tacked all around outer edge of arm. Then fabric is blind-tacked along top edge by tacking through cardboard strip and rear side of fabric. Cardboard is concealed when fabric is pulled down



on the spring. One of the best ways to stretch the springs is to grip the free end with the claw of a hammer. With the hammer held in the right hand, left hand is used to press downward on the crown of the spring as it is pulled forward and hooked in the clip. As each spring is stretched in place, remember to alternate the direction of the bent ends.

Helical springs installed next: Helical springs are used to connect the sagless-type springs together crosswise so they will function as a unit and spread the seating load evenly over all the springs. When installing the helical springs, be sure the open hook of the coil is placed downward so that the hook will not snag the burlap covering and foam-rubber padding. At least two rows of helical springs should be used, three are better. These are anchored to the side seat rails with retainer plates which are sheet-metal hooks that are nailed vertically to the outside face of the rails. The plates should be spaced evenly three or four spring loops apart along each rail, and should be nailed at a height on the rail that will permit a straight sideward pull against the outside row of sagless-type springs.

Applying springs in the back is done practically the same as described in springing the chair seat. Here, the



After foam rubber is applied to bolster, the rubber is cut with scissors all the way through to burlap. This allows the bolster to be deeply tufted when it is covered



Above, wooden frame to which sagless springs are applied and then covered with burlap, is designed to take standard, cored foam-rubber mattress. Below, helical springs are added to sagless springs of bolster

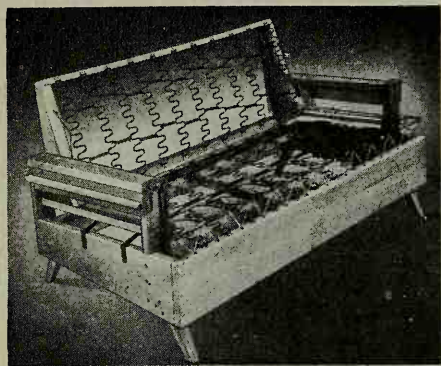
springs are stretched from the back liner (lower crossrail) of the frame to the top rail. Two or three rows of helical springs are installed across the back as was done in the seat. However, the springs at the ends of the rows are held to the frame with staples instead of retainer plates. After all the springs are installed in both the back and seat, the springs are covered with burlap which is drawn taut and tacked to



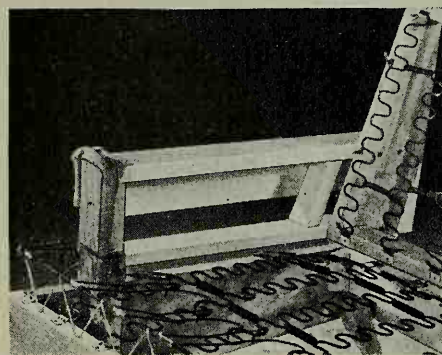
Below, bolster is "wrapped" with fabric which is brought around and tacked to ends of frame. Separate plywood panels, covered with fabric, cap each end

Below, before foam rubber is applied, edge roll is tacked all around each end of bolster to soften the hard edges of frame and produce recess for end panels





Above, this photo of the Davenport shows it ready for the foam-rubber padding. Note the spring edge wire that is required across front of T-type seat



Above, edge roll is tacked around the front of each arm to soften hard edge and prevent excessive cover wear. Notice torsion spring and how edge wire is tied

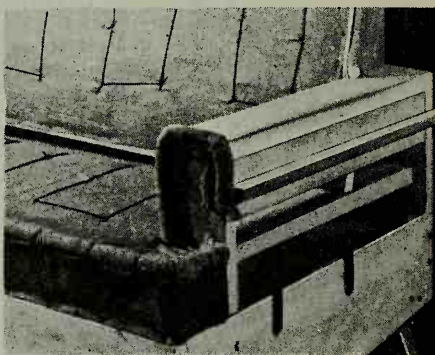
the top edges of the wooden chair frame.

Adding foam-rubber padding: Padding the springs with foam rubber is much simpler than padding them with loose stuffing, as the rubber is of uniform thickness and density. Foam rubber comes in cored and plain slab stock of various densities. Rubber of extra-soft density is recommended as a topping over back springs. Rubber of medium density is best for soft seats, with or without springs. Rubber of soft density is used for both back and seat padding. Plain slab stock (not cored) of

UPHOLSTERY ALLOWANCE

0 to 6"—Allow $\frac{1}{4}$ " over-all	36 to 48"—Allow $1\frac{1}{4}$ " over-all
6 to 12"—Allow $\frac{1}{2}$ " over-all	48 to 60"—Allow $1\frac{1}{2}$ " over-all
12 to 24"—Allow 1" over-all	60 to 72"—Allow 2" over-all

These allowances can be varied slightly when extra soft or very firm foam rubber or rubberized fiber is used. When using extra-soft stock add more to these allowances and when using very firm stock less allowance can be made.



Above, close-up view of arm and corner of seat show how edge roll should lace. Roll is tacked to arm and sewed to seat. Long stitches fasten burlap to springs



Here Davenport is fully padded with foam rubber. Notice muslin tacking strip across the front edge

medium density is used for padding the top and inside surfaces of arms, slip seats, benches, shaped seats and thinly padded chair backs.

A paper pattern should be made of all parts that are to be padded with foam rubber. To assure that the fabric cover will fit snugly, the foam rubber should be cut slightly larger than the pattern. Consult the chart on page 168 for proper allowance. The pattern can be traced on the foam rubber with an indelible pencil, ball-point pen or colored pencil. A few pins will hold the pattern in place while tracing. Any thickness of solid-slab foam rubber can be cut completely through with scissors. The same applies to cored stock up to 2 in. thick. In the case of heavier stock, it is best to make the first cut through the smooth top surface deep enough to sever the top of each core. Then cut through each core well. The scissors should be dipped in water frequently to lubricate them and make cutting easier.

Cementing foam rubber: Foam rubber is cemented to the burlap over the springs to hold it in place. Both the burlap and foam rubber is given a coat of special cement made for the purpose and allowed to become tacky before placing the foam-rubber slab in position. In the case of cored stock, the cores should first be dusted with talcum powder to prevent any cement from sticking that might run down inside the cores. Slabs of foam rubber may be cemented together edgewise in the same way when building up several pieces for width. After several hours, the bonded seams will be stronger than the foam rubber itself.

Applying tacking tape: Foam rubber is held to the frame with tacking tape. This is a strip of muslin which is cemented to the outer edges of the foam-rubber slab and tacked to the frame. It also helps to reinforce the edges of the rubber. The tape is applied by coating the edges of the foam rubber and the tape, a distance of 1 in. along the edge with cement, and sticking the two coated surfaces together after they have dried a minute or two.

From here on the job is completed in the normal way, pulling the fabric cover on over the foam rubber and tacking it to the frame. As a rule, a conventional muslin cover is not required over foam rubber, except where the cover is a pile fabric like cut velvet.

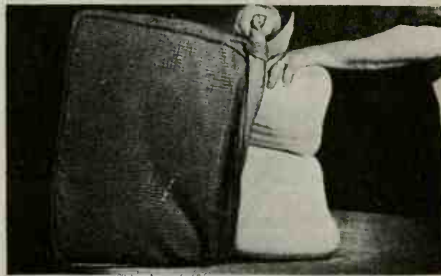
While the steps described here have been presented briefly due to limited space, a much more detailed explanation of working with sagless-type springs and foam rubber may be found in a book written by the author, John Bergen, which covers the subject completely. ★ ★ ★



Above, solid slab stock is sandwiched between two cored slabs and then all three are cemented together



Above, strips of solid slab rubber are cemented to edges and at four corners of built-up center portion



Above, built-up foam-rubber pad is inserted in a stitched-fabric cover and then open side of cover is hand-sewn shut along welt edge of the cushion





HOW TO BUY A USED

BUYING A USED CAR need not be a gamble, for even the most inexperienced person can take steps to assure himself of a reasonably safe buy. Your best bet is to patronize a local dealer with a good reputation, who has been in business in your area for a number of years. Beware of so-called "sensational bargains," remembering that a legitimate dealer must make a profit to stay in business. Be cautious about warranties and guarantees. Space does not permit a lengthy discussion about these widely advertised documents, but be sure to read them carefully and analyze the wording thoroughly. In many cases they actually mean very little, and sometimes obligate the car purchaser to assume costs for repairs that should have been reflected in the purchase price. This is another excellent reason for being very careful of bargains. Though the original price is low, in the long run the car will cost more than one with a higher selling price. Do not make a hasty purchase, but shop around for a few days to get an idea of the market value of the car you want. Once you have located the make and model you desire—it is better to have spotted three or four—hire a good mechanic to look over the car. He will know how to pick a car that is in good condition, and his fee may be one

of the best investments you ever made.

However, if you must depend on yourself to make the selection, here are some simple checks that will help you to avoid buying a car that has been abused, wrecked or is otherwise not a desirable automobile.

Except for automatic transmissions on many of the later models, the checks for quality in a used car are still much the same as always. Don't let a dazzling paint-and-polish job fool you. It might, indeed, be used to cover extensive damage. Banged fenders, rusted doors and other fairly minor items, properly repaired, are not things which should stop you from buying. But look behind the sheet-metal damage and check the frame. If the chassis shows signs of having been heated and straightened, or if there are welds evident, pass up the car, even at a bargain. Although the tires and running gear do not at this time show signs of wear from misalignment, eventually there will be trouble.

While checking the running gear, take a look at the front end. The independent suspension is an expensive unit to have repaired. If the front wheels are spraddled, with the bottoms out farther than the tops, leave that car alone. And if the wheels are properly vertical or slightly out at the top, check to see that the wheels haven't been



CAR

toed-in excessively to get them to look right. With the front edges of the wheels too close together, the tires will wear rapidly. If possible, jack up one of the front wheels and rock each wheel to check for wear in the kingpin and spindle-support bushings. If it is excessive, it will cost around a hundred dollars to have the front end rebuilt. Wobble the wheel in the other direction to

Jack up the front end and rock the wheels to check for wear in the kingpin and spindle-support bushings



check for worn tie-rod ends. This is not a major fault, but should be corrected immediately for good steering and to prevent undue wear on the front tires. Front-wheel tires that are cupped or worn at an angle definitely indicate something wrong with the front suspension. With the car on the ground, stand on the front bumper and rock the car with your weight. If the front end bounces easily, the shock absorbers are worn. On many cars the shock absorbers are an integral part of the front suspension and it requires overhauling most of the suspension to replace them. Good shocks will snub a car's roll after one or two bounces. The rear shocks may be tested in the same way. Assure yourself, also, that neither rear spring is weak or broken.

Check all the door latches to make sure the doors close properly and stay shut. Do the locks work? With children this is an important item. Roll the windows up and down to make sure the cranking mechanism is in working order. With the door open, compare the paint color on the edge with the color on the body. A different color here will show a repaint job. Good condition of the upholstery and floor mats generally indicate that the former owner took good care of the car, but it is possible also that seat covers have been stripped off and inexpensive floor mats installed. If the car has conventional transmission, new pedal pads might also indicate that the old pads showed excessive wear because the car had been used extensively for stop-and-go driving. This type of driving is much more destructive than high-speed, long-distance driving, when the motor is at operating temperature and the oil is properly circulating.

Turning on the key will check the gas gauge and ammeter. Start the engine and

Sheet-metal damage that has been properly repaired should not keep you from buying a used car





Stand on the bumper and rock car with your weight to check the shock absorbers. If the car bounces easily, the shocks are worn and will need replacing

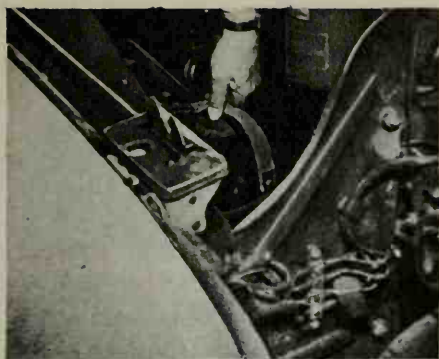
Check the camber and toe-in of the front wheels. The wheels should be vertical or slightly out at the top. Toe-in should be very slight or zero



watch the oil pressure. It will run high at first, then as the engine warms up, will drop to normal. Covering the radiator with a blanket will quickly bring the engine up to normal operating temperature. If the oil pressure drops too far below normal, then the bearings are badly worn. To correct this will require a complete overhaul. While sitting in the driver's seat, test the brake pedal. It should be fairly firm and have about $\frac{3}{4}$ -in. of play. If the pedal goes lower than this, but can be brought up by one pump, it is probably the adjustment. Twist the steering wheel to feel any slack in the steering-gear box or linkage. If it is excessive it should be adjusted. Get the dealer to make all the necessary adjustments and corrections before you buy any car. It is a lot easier before than after he has the money. Snap on the lights to make sure all the bulbs are good. High and low filaments in the headlights, stop and taillights in the rear. If there are directional and back-up lights, check these.

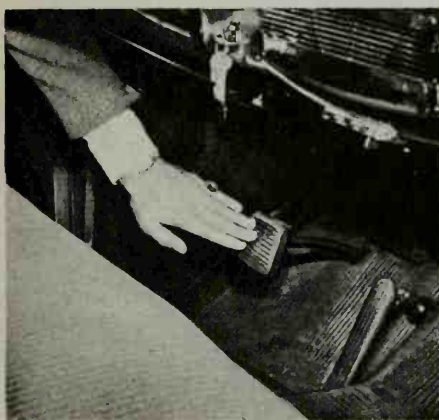
Raise the hood and inspect the engine. Here, again, cleanliness does not mean as much as it might. The engine can be steam-cleaned and painted. This does nothing for the efficiency of the inside of the engine. Pull out the dip stick and note the condition of the oil. If it is heavy, it could mean that the engine is noisy and needs heavy oil to quiet it. Or it might use too much oil of a lighter viscosity. Either way, the engine will require an expensive overhaul.

When testing an engine be sure to bring it to operating temperature. This is important because some modern engines with cam-ground pistons and extreme cold clearances will be noisy until the engine is completely warmed up. When the engine is warmed up, race it and check for noise. In a flathead (L-head) engine, any loud clunks or continuous raps mean something is badly worn. On an overhead-valve engine, some noise can be tolerated because it is difficult to keep tappets and rocker arms absolutely quiet. If the motor is quiet, but seems sluggish, have the timing checked. If the spark is greatly retarded, it can hide a connecting-rod knock or other noise.



Battery and cables should be free of corrosion

Brake pedal should have a maximum play of $\frac{3}{4}$ -in.



While gunning the engine, look out the back at the exhaust. A cloud of blue smoke is the giveaway of an oil-burning, badly worn engine. Black smoke shows that the engine is running on too rich a mixture of fuel. Usually a carburetor overhaul by a competent mechanic will cure it.

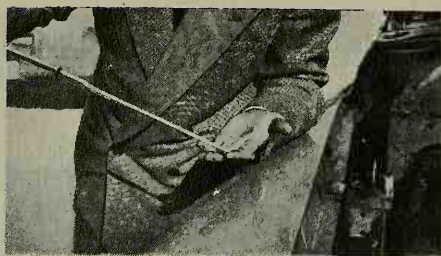
Examine the battery. New batteries are guaranteed from one year to about three. The age of the car subtracted from the original life expectancy of the battery will not give it too much time. It is a sensible precaution to get a new battery for any used car you buy that is much more than a year old. If, however, the battery case is clean and the battery cables and clamps are not badly corroded, there is usually a fair amount of life left in the battery. Follow down the cables to see that they are not loose or corroded on the starter and ground. The wiring to the coil and distributor, as well as to the spark plugs should not be oil-soaked or rotten. Shorts anywhere in the wiring can cause poor engine performance and low mileage, and



will cause an excessive drain on the battery.

Does the radiator show signs of leaking? Excessive loss of water or antifreeze will badly damage an engine in a matter of minutes and a new radiator is an expensive item. Soft or rotten radiator and heater hoses may burst at any time. An old hose sheds small particles of rubber and fabric that can clog a radiator.

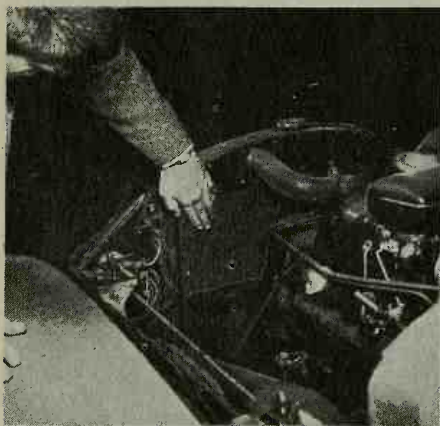
Test-drive the car. Accelerate in all three gears, if the car has conventional transmission. In each gear listen for a growling or grinding that would indicate worn gears in the transmission or differential. If the car has an automatic transmission, run in all ranges on the indicator, and out on the highway, use the passing gear a time or two to see that it functions properly. With any automatic transmission the engine must be properly tuned to get smooth performance. So, before driving any car equipped with an automatic transmission, listen to the engine while it is idling to see if it runs evenly. Accelerate the engine suddenly. Does it hesitate a



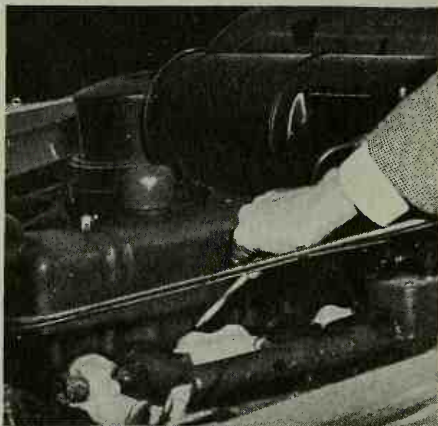
The motor oil tells a story. Heavy oil indicates that the engine is noisy and needs to be quieted or that the car uses too much of a lighter oil



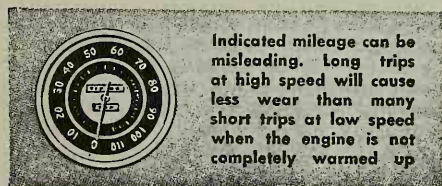
A cloud of blue smoke from the exhaust shows that the car is an oil-burner. Correcting this condition requires a complete engine overhaul which is costly



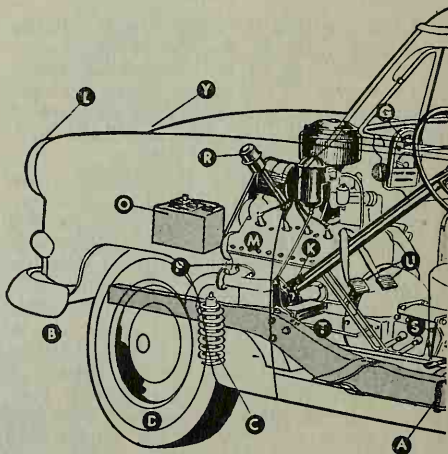
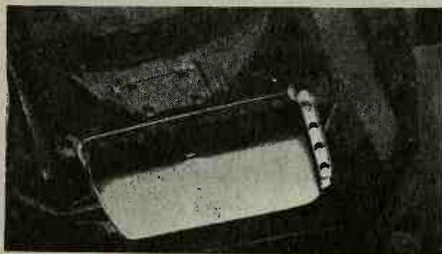
Replacement or repair of a radiator is expensive. Leaks around soldered joints are easily repaired



Leaking gaskets around the exhaust manifold may allow deadly carbon monoxide gas to enter car

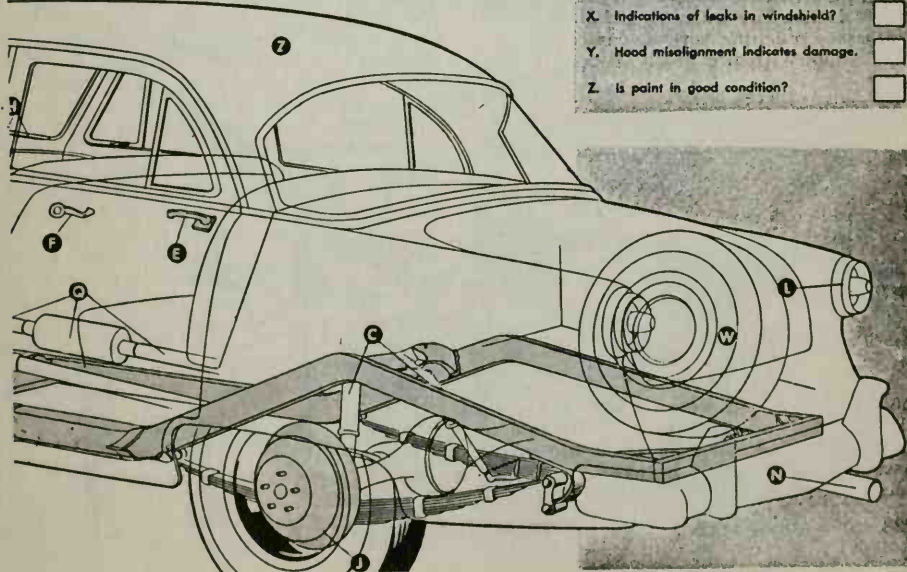


If the oil pan on the bottom of the automatic transmission shows oil leakage, future trouble is indicated



moment before "revving" up? It might be carburetor trouble, possibly the accelerator-pump system. In some cases a worn distributor or burned points will give this effect. Too wide a gap in the spark plugs will do it. Drive along at about 10 m.p.h. in high gear, then suddenly floor the gas pedal. If the motor shakes badly, vibrating the whole car, the valves will need regrinding. With any of these engine troubles, the automatic transmission cannot function properly. If you think you'd like to buy the car, have the dealer properly tune the engine, then road-test it again to make sure the rough engine did not conceal a faulty transmission. One of the biggest problems with automatic transmissions is that they will leak oil. A look under the car will show an oil pan bolted to the bottom of the transmission. If this pan shows oil leaks around the pan gasket or at either end where the drive shaft and engine connect, the oil seal should be replaced or the gasket renewed. Be sure this condition is corrected.

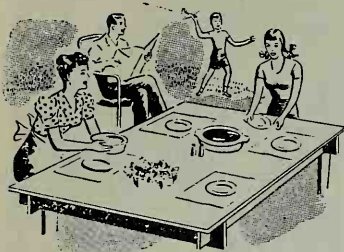
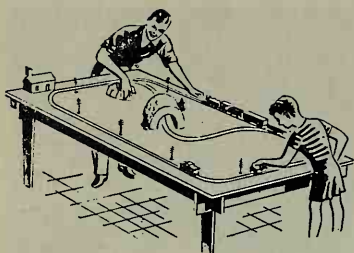
Although many of the items mentioned are, in themselves, minor, a number of them can add up to an expensive, unreliable means of transportation. And a number of visible defects indicating that the car has not been properly cared for by its previous owner, are an assurance that there are many other faults which you cannot see. Next to a home, the average man pays more for an automobile than for anything else he buys. Keeping this fact in mind, investigate carefully, for when spending so large a sum of money you are entitled to know that you are getting your money's worth. If the salesman does not want to let you check thoroughly, you can assume that something is wrong with the car. Buy only when you are absolutely sure. And finally, when deciding on the maximum amount you can safely spend for a used car, deduct fifty to one hundred dollars for possible repairs, even on the best car selected from the stocks of a reliable dealer.



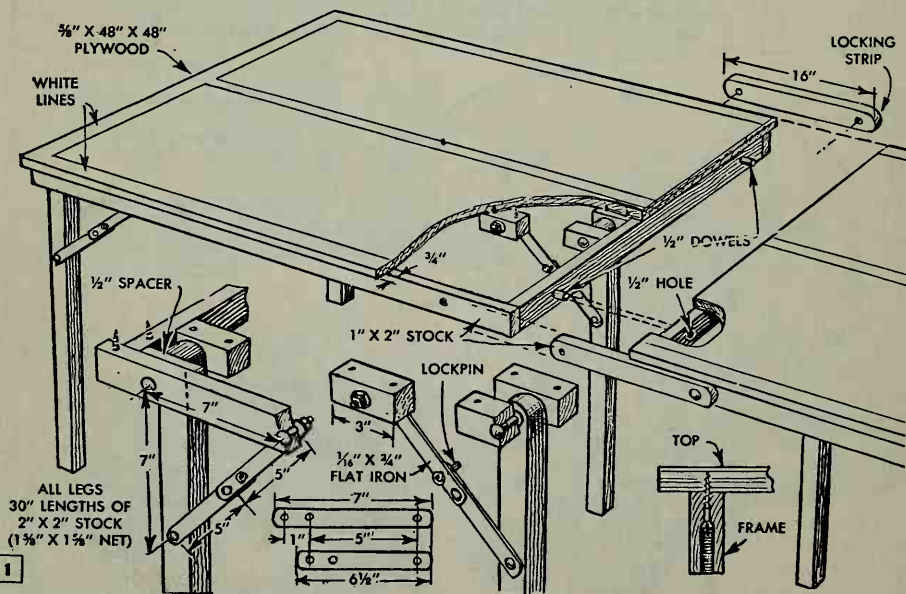
CHECK LIST

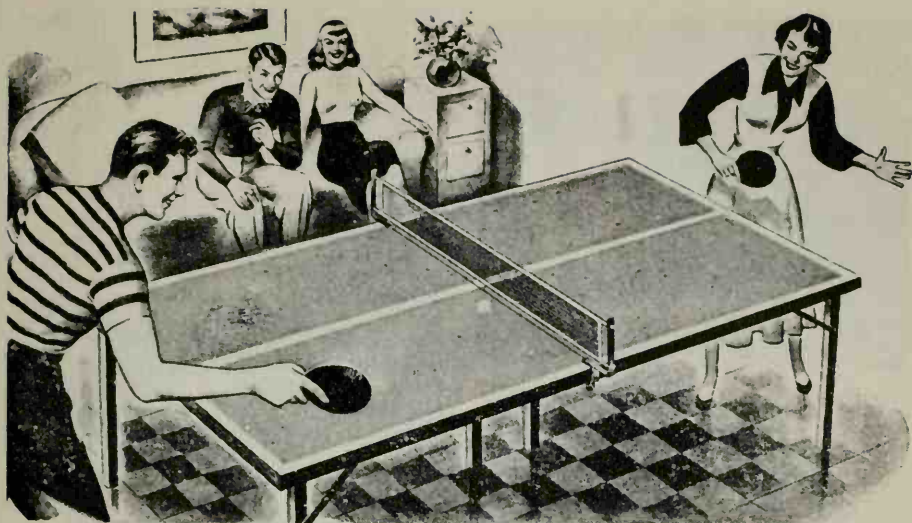
- A. Frame damaged or welded? ☐
- B. Front wheels properly aligned? ☐
- C. Shock absorbers badly worn? ☐
- D. How good are the tires? ☐
- E. Door latches and locks work? ☐
- F. Window-raising mechanism work? ☐
- G. Do all the instruments function? ☐
- H. Heater, defroster and radio operate? ☐
- I. Oil pressure stay constant? ☐
- J. How good are the brakes? ☐
- K. Slack in the steering gear? ☐
- L. All lights operating? ☐
- M. Engine noisy when warmed up? ☐
- N. Oil smoke from exhaust pipe? ☐
- O. In what condition is battery? ☐
- P. Exhaust manifold gaskets leak? ☐
- Q. Leaks in exhaust system? ☐
- R. The motor oil tells a story ☐
- S. Transmission noisy—leak oil? ☐
- T. Clutch slip or grab? ☐
- U. Worn brake and clutch-pedal pads? ☐
- V. Front-seat mechanism operate? ☐
- W. Good spare tire and wheel? ☐
- X. Indications of leaks in windshield? ☐
- Y. Hood misalignment indicates damage. ☐
- Z. Is paint in good condition? ☐

UTILITY TABLES



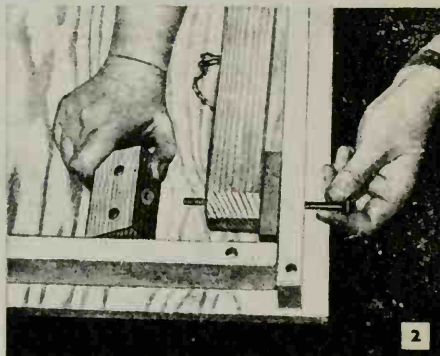
THESE all-purpose plywood tables will have many uses around the home, three of which are suggested at the left. The tables also can be readily taken apart and stored in small space when not needed. The one shown on the opposite page is made from a 4 x 8-ft. panel of plywood cut in half, making two separate sections with side rails and folding legs added. Locking strips and wing-nut bolts fasten the sections together for use as one large table. After making the top in two separate 4 x 4-ft. squares, thoroughly sand the edges and make the framework or side rails. These are glued and screwed to the lower side of the top boards, using 1 1/4-in. screws in countersunk holes drilled through the edge of the side rails as shown in the detail, Fig. 1. Round off the top ends of the legs and cross drill for the 1/4-in. bolts which hinge them to the mounting blocks, Fig. 2. The legs are held in the open position by folding table brackets, which may be purchased ready to attach or made up from flat iron to the dimensions shown in Fig. 1. Care must be used in laying out the dimensions for the screws holding these brackets in place. Any inaccuracy in locating the screws will prevent the legs from folding properly. The detail in Fig. 1 shows the dimensions for brackets, how they are riveted together and the location of the drilled holes for



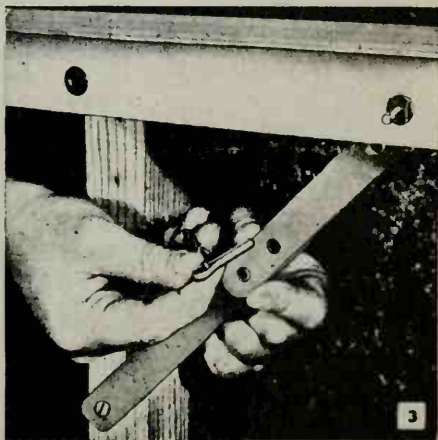


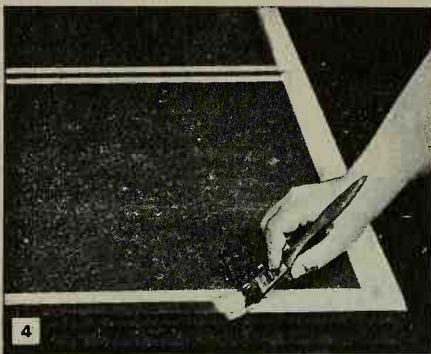
inserting the cotter key, Fig. 3, when the brackets are extended for locking the legs in use. Center locking strips for holding the two table sections together are made up from 1 x 2-in. stock 16 in. long. Matching holes are drilled through the strips and into the table side rails for the insertion of $\frac{1}{4}$ -in. bolts, which are fitted with wing nuts for quickly clamping the two parts together, or for quick removal when collapsing the table for storage. When the carpenter work has been completed, thoroughly sand the various parts and apply two coats of exterior enamel undercoater, painting the entire table surfaces, top, bottom, side rails and legs as well. When dry, apply a third coat of exterior, dark-green, flat-finish enamel. While 5 x 9 ft. is the regulation size for a table-tennis table, the game can be played on this undersize table. The white lines can be made $\frac{3}{4}$ in. wide and neatly applied by first laying off the lines with decorator's masking tape, as in Fig. 4. Be sure edges of the tape are firmly pressed down in perfect contact with the table top at all points so that the paint cannot run under. Two coats of white paint will be needed to make a good finish. When the paint has thoroughly dried the tape may be stripped off.

The utility table shown in Fig. 5 is entirely of plywood construction. The simple lock joints, which hold the base rigid without the use of any fastenings, allow the table to be quickly assembled for use or readily taken apart for storage. It is of regulation height for table tennis. If the table is to be used outdoors it should be built of exterior-type plywood which will



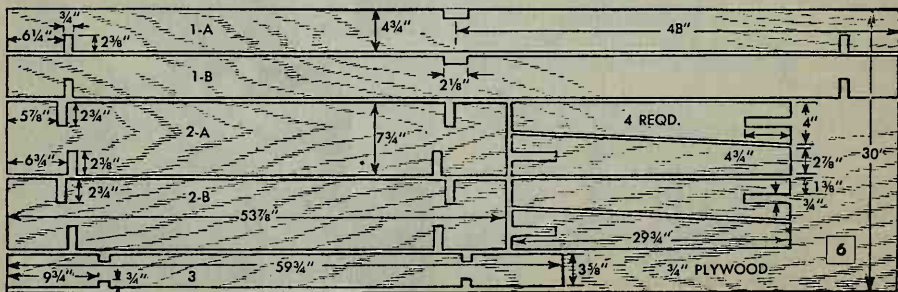
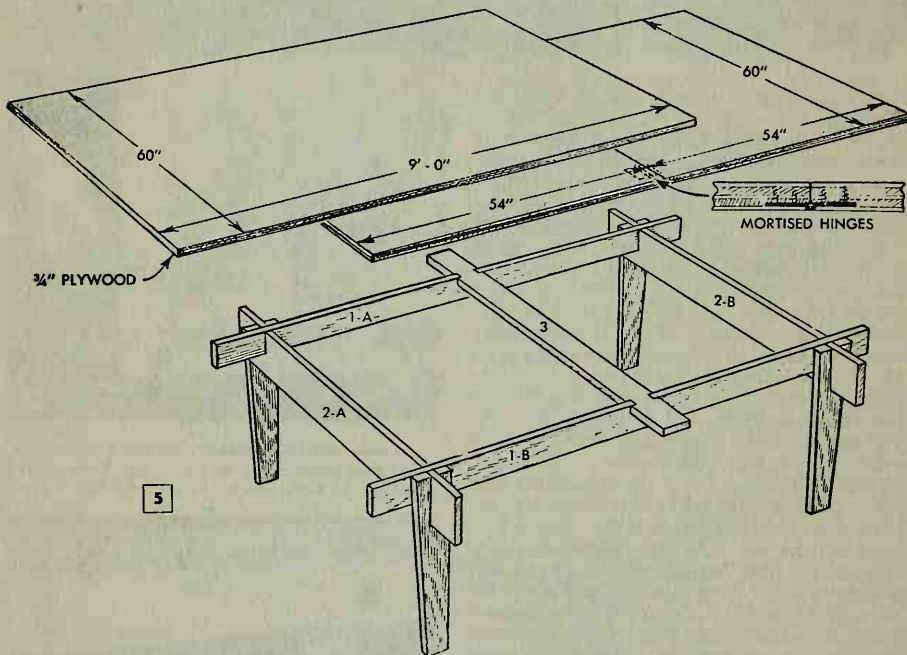
Hinge legs with bolt through side rail and mounting block; then screw block to table top. Below, insert cotter key in table bracket to lock the leg in place





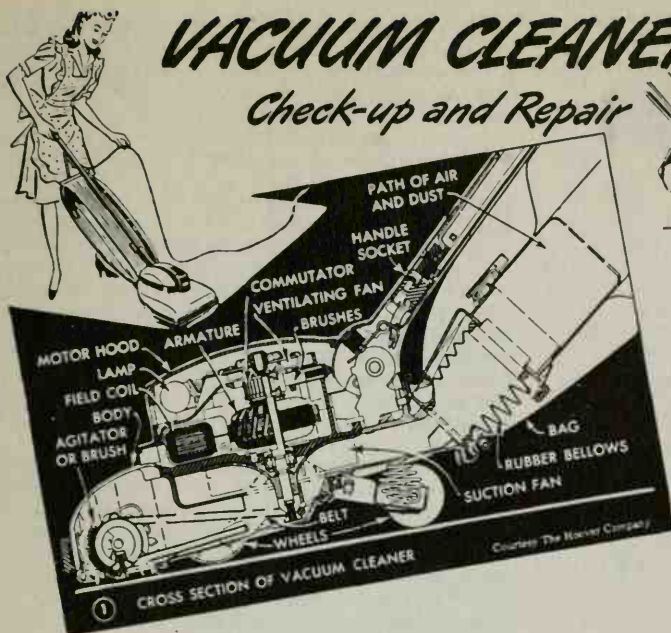
Paint white lines around the edge and lengthwise down the center of the table top. Lay out lines with decorator's masking tape. Apply paint with soft brush. Strip off tape when paint is thoroughly dry

stand up well under all weather conditions. For indoors, where not permanently exposed to weather or repeated wettings, use the ordinary grade of plywood which is considerably less expensive. Panels $\frac{3}{4}$ in. thick are preferred. The top can be made from one piece, 5 x 9-ft., which can be had on special order, or two pieces 5 x 4 $\frac{1}{2}$ -ft., hinged in the center, as shown in the detail in Fig. 5. The pieces for the base, the rails and the legs, can all be cut from one 96 x 30-in. panel. Carefully mark the frame pieces to the dimensions shown in the drawing, Fig. 5, and cut them with a sharp handsaw or power equipment if available. The notches in the various panels should be be accurate in width. They can be made easily by drilling a hole at the bottom line and sawing each edge into the hole. The corners can be trimmed with a chisel.



VACUUM CLEANER

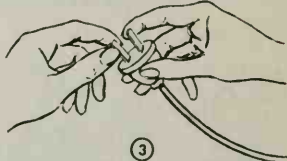
Check-up and Repair



ALTHOUGH a vacuum cleaner is one of the most reliable mechanical devices in the home, there comes a time when it needs servicing and minor repairs—if for no other reason than to keep it in top-notch working condition. In doing its job of collecting dirt in the dust container, certain parts of the cleaner take plenty of punishment. Cut a cleaner in half, as in Fig. 1, so you can view it “in section,” as the draftsman calls it, and it looks like a complicated piece of machinery. But in reality its operation and its parts are quite simple. Essentially it consists of a centrifugal suction fan, a dust bag or container, a suction nozzle and a small electric motor which drives the fan. And that’s all, except a handle perhaps, a light to illuminate dark corners and, on certain types such as that in Fig. 1, small wheels and casters for easy maneuverability. Most cleaners of this particular type also are fitted with an agitator brush, its purpose being to loosen embedded dirt so that it can be picked up by the air stream. This brush and the dust bag or container are the two parts requiring the most frequent attention. When emptying the bag, the directions furnished by the manufacturer of the cleaner should be carefully followed, of course, but a common procedure is to hold the bag over a sheet of paper with the open end down, place your feet on the corners of the frame and shake the bag vigorously, as in Fig. 2. Turn the bag inside out occasionally and carefully brush off the accumulated film of fine dust. Never wash the bag as this will likely destroy its properties of dust retention.

The agitator brush should be removed occasionally and thoroughly cleaned. Lint, thread and string often wind so tightly on this brush that it’s impossible to untangle the mass. But you can cut through the strands with shears and remove them with a comb as in Fig. 4. Be careful not to break the bristles of the brush. Check the length of

② EMPTY THE BAG AFTER EVERY CLEANING



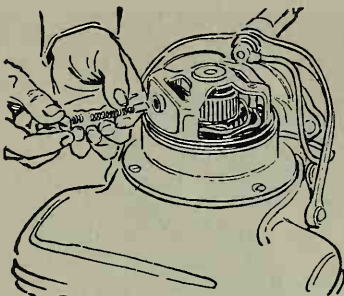
③ IF PLUG DOES NOT MAKE CONTACT, BEND PRONGS OUTWARD SLIGHTLY



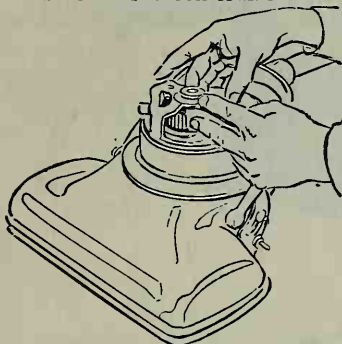
④ CUT TANGLED THREAD WITH SHEARS AND REMOVE WITH COMB



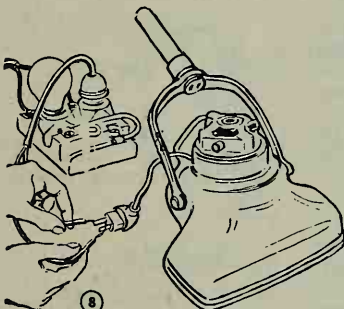
⑤ CHECK LENGTH OF BRISTLES BY LAYING CARD ACROSS NOZZLE



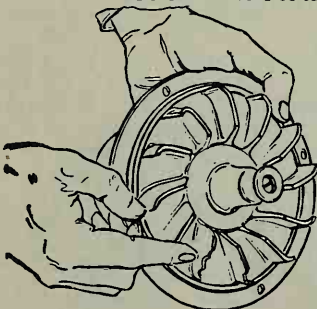
6 INSPECT MOTOR BRUSHES.
IF WORN THEY SHOULD BE RENEWED



7 EXAMINE THE COMMUTATOR AND
CLEAN WITH FINE (8-0) SANDPAPER



8 A TEST LAMP IS USED TO CHECK FOR "OPEN"
CIRCUIT IN FIELD OR ARMATURE COILS



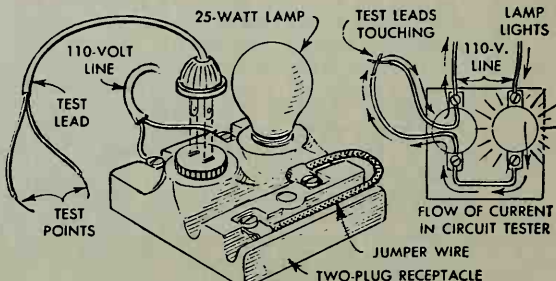
9 BROKEN FAN BLADES WILL CAUSE
VIBRATION AND WEAR ON MOTOR BEARINGS

the bristles occasionally as in Fig. 5. Also check the agitator belt tension to see that there is no slippage.

Sometimes a cleaner will start and stop at intervals when the switch is turned on, or it may simply refuse to run. When this happens the first part to examine is the plug, Fig. 3. Usually you'll find that the plug is loose in the receptacle and this means that the prongs are making only intermittent contact. The remedy is to bend the prongs outward slightly, or if the prongs are unusually loose when inserted in the receptacle it often helps to bend the ends of the prongs with pliers.

At long intervals it will be necessary to replace worn motor brushes, Fig. 6. Unscrew the brush caps and examine the brushes occasionally. Handle brushes carefully and be sure to return them to the sockets exactly as they were taken out. Don't turn the brush over. A commutator in good condition should be reasonably clean with the brush track somewhat darker in color. If the track is pitted, burned or coated, the brushes are not making proper contact. This causes arcing and results in a rough commutator surface, which of course grows worse with continued use. The remedy depends on the condition of the parts. Sometimes merely cleaning the commutator surface with fine sandpaper as in Fig. 7 will be sufficient. However, if it is rough and pitted or grooved, then, if tests show the motor otherwise in good condition, it will pay to have the commutator trued up and the mica undercut by a competent service shop. Whenever you have the cleaner apart for any reason, give the fan a thorough going over. There might be a cracked or bent blade or maybe a piece broken out as in Fig. 9. This will cause vibration which in turn greatly accelerates wear. If any of the blades are cracked or broken, a new fan is the surest remedy.

If you suspect there's need to check over the cleaner electrically, then make up the simple circuit tester detailed in Fig. 10. Begin by plugging the cleaner cord into the tester and turning the switch to the "off" position. If the lamp lights there's a short somewhere in the cleaner. Check switch cords and leads to the motor to locate it. If, on the other hand, the lamp does not light with the switch in the "off" position, snap it to the "on" position. If the lamp still does not light, there's a short somewhere along the line of the electrical circuit. Check the plug for breakage or loose wire connections, also



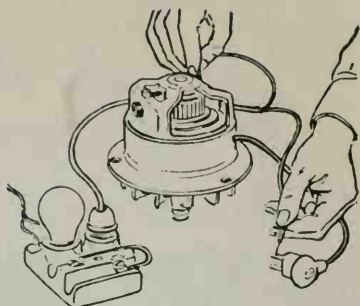
10 A SIMPLE CIRCUIT TESTER FOR CHECKING
CIRCUITS IN ANY ELECTRICAL APPLIANCE

the wires to the cleaner switch plate. Shake the cord all along its length and note if the lamp flickers at any point. If nothing happens, disconnect the cord from the motor, twist the wires together and plug the cord into the circuit tester. The lamp will light if the cord and switch are intact.

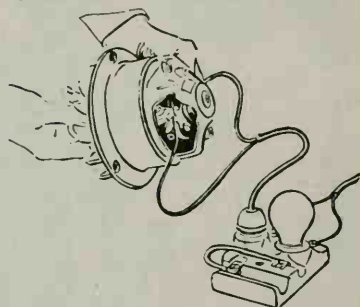
To test for open circuit in field or armature coils proceed as in Figs. 8 and 12. The lamp will light unless there is a burned or open field coil. If turning the fan slowly, Fig. 12, produces a uniform flicker of the light, everything is okay. But if the flicker is unsteady, turn slowly to find a point where the lamp goes out. Ordinarily this will indicate an opened commutator segment.

To test field coils proceed as in Fig. 14, connecting the complete set in series across the line voltage and measuring the voltage drop across each coil. A low reading indicates a short in the coil being tested. Fig. 15 shows the circuit of a universal motor, a common type in vacuum cleaners. Fig. 11 illustrates tests B and C, shown diagrammatically in Fig. 15. Although a light shows that the coil being tested is continuous, the insulation may be burned off. Test D, Figs. 12 and 15, checks coils of the rotor or armature. If the lamp does not light then test each adjacent pair of commutator segments as at E, Fig. 15. No light indicates that the coil is burned out between those two segments. The motor will not start if it should stop when a brush is in contact with the dead coil. If the test lamp lights when making the test F in Fig. 15, illustrated in Fig. 13, insulation has been scraped or burned from the armature coil, or coils, and the armature is grounded to the shaft.

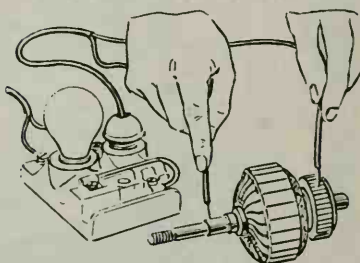
If the test lamp fails to respond when it should light, make a careful inspection of the particular circuit you are testing. Unless the motor is burned out or otherwise damaged, making replacement of the whole unit necessary, breaks usually will be found near the ends of the wires where it is easy to make a lasting repair. Generally the cord is the first offender. When you coil or uncoil it from the cord brackets on the cleaner be careful not to kink it. If you should happen to pull out a sharp kink you may break the strands of one or both the wires as well as the insulation. Other than the cord, most repairs are necessary only after a long period of hard service, unless of course the cleaner is damaged. Often it's a question of deciding which to do, repair the damaged part or renew it entirely.



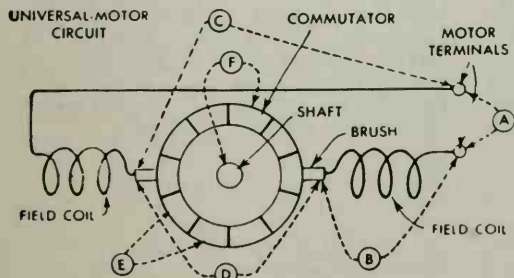
11 LIGHT SHOWS THIS FIELD COIL IS CONTINUOUS ALTHOUGH IT MAY BE SHORTED



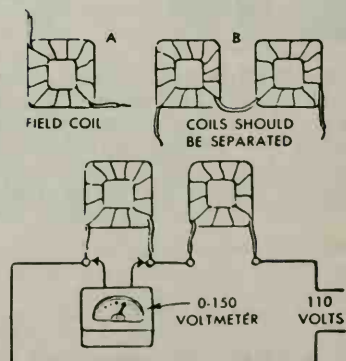
12 TURN FAN SLOWLY TO CHECK ARMATURE COILS FOR "OPEN" CIRCUIT



13 LIGHT HERE INDICATES THE ARMATURE COIL IS GROUND TO THE SHAFT



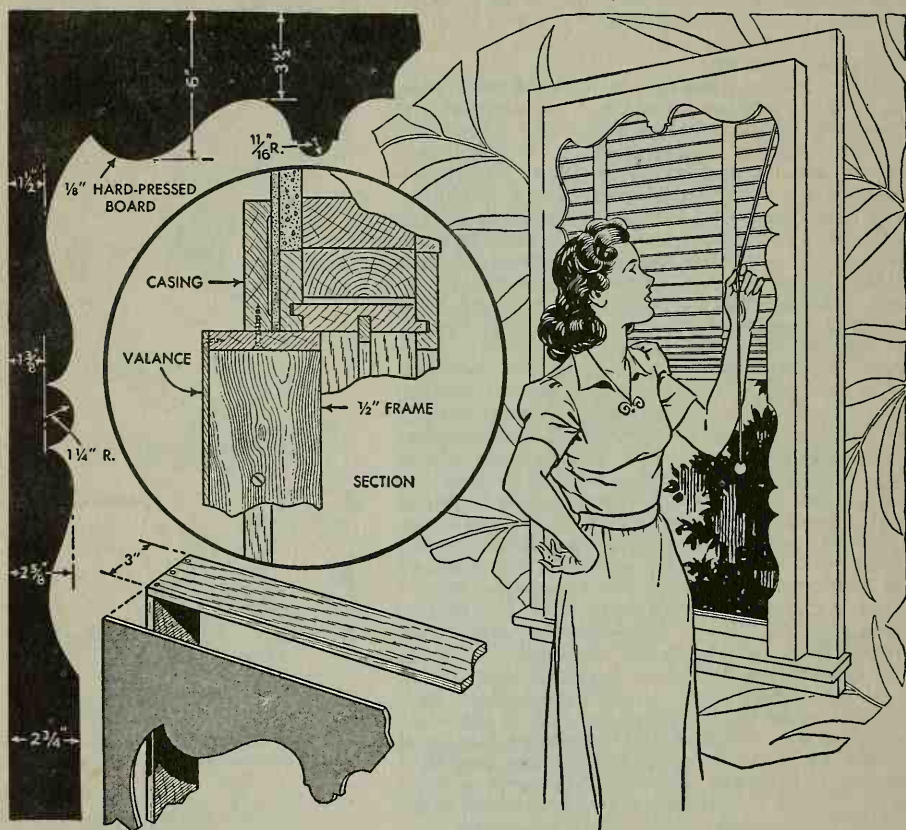
15 TEST LAMP SHOULD LIGHT AT ALL LETTERED POINTS EXCEPT (F)



14 A LOW VOLTMETER READING INDICATES A SHORT CIRCUIT IN THE FIELD COIL

VALANCE

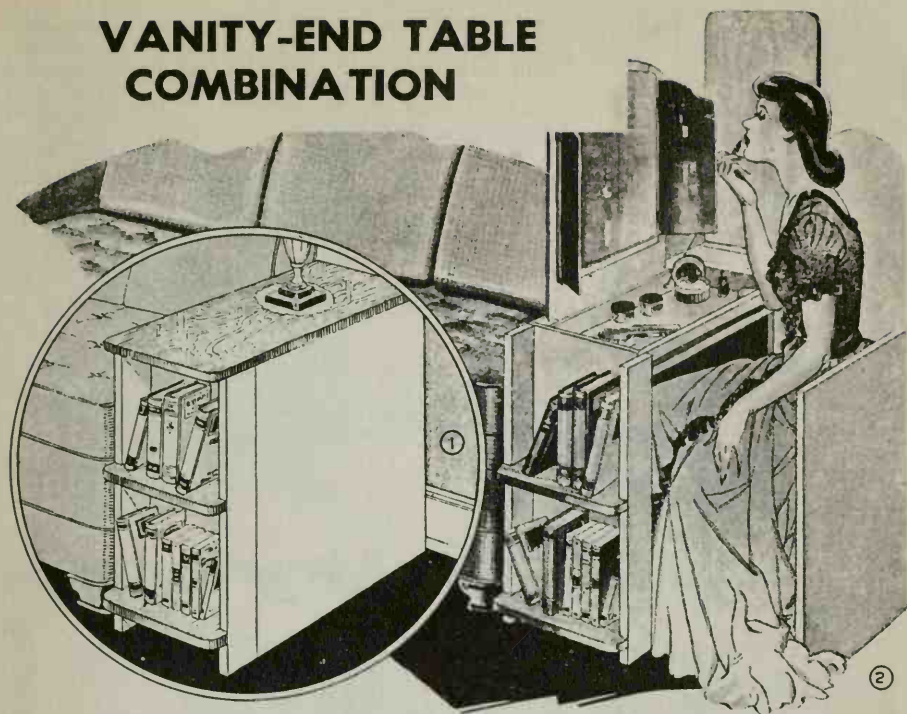
Three-Sided Valance Dresses Up Plain Window



Scrollsawed from hard-pressed board and fitted across the top and down the sides of a window, a three-side valance often improves its appearance. A frame of $\frac{1}{2}$ -in. stock is fitted inside the window casing and screwed to it as indicated, after which the valance is screwed to the frame. The latter

must be at least 3 in. deep if the window is covered by a Venetian blind as this much space is necessary to operate the blind. As used originally in the U. S. Gypsum model research home, the valance was painted to match the walls, but it could also be painted to harmonize with the woodwork.

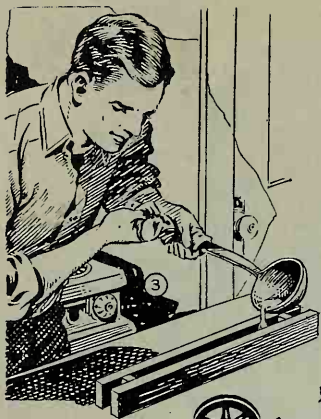
VANITY-END TABLE COMBINATION



The attractive double-duty end table illustrated above opens into a midget vanity complete with chair that nests flush to conceal the drawers in front. Especially suitable for use in one and two room apartments where the living room doubles as a bedroom, this compact unit makes the most of limited space by serving both as an end table and a vanity as shown in Figs. 1 and 2 respectively. In pairs they go well at the ends of a studio couch. In this case, only one would be made a vanity, the front of the table being one solid panel and the top fastened instead of hinged. Cutaway views in Fig. 6 show the general construction. A paint-and-varnish job can be had by combining walnut with fir, which will cut the cost and at the same time give a pleasing two-tone effect. Make the unit housing the book niches first. Note in Fig. 7 that a notch is made in the plywood back of this to take the end of the front crossrail. Notice too in Fig. 6 that the rear rabbet is cut wider than the front one to receive the overhanging back of the mirror well. End posts of the latter are grooved 1 in. deep for the panel to which the mirror is attached. Locate the grooves to allow room for a counterweight as in Fig. 4 and cut them a little oversize to assure free sliding of the panel. The front panel of the well can be

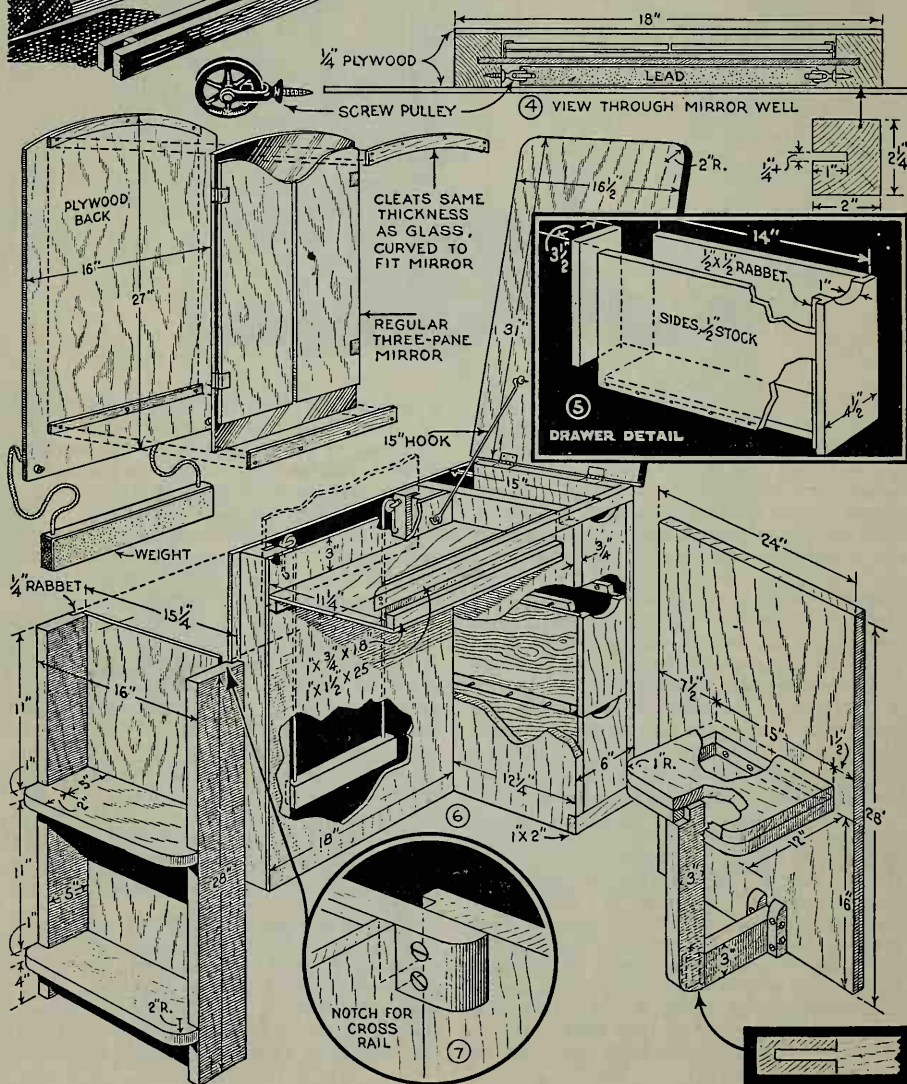
glued and screwed in place, but the back one should be screw-fastened only to enable you to get at the mirror and counterweight easily. The triple-pane mirror, which can be purchased at a department store, is held to the backing panel by cleats fitted to overhang the top and bottom edges of the glass. The counterweight must equal the combined weight of the mirror and the panel to which it is attached. The weight can be cast of lead, if available, in a simple wooden form as in Fig. 3, or of concrete. Resorting to the latter will require the use of a deeper form to obtain a casting equal in weight to one of lead. Either drill or cast holes in the counterweight for the cords and knot the ends to prevent pulling out. Then run them up over the screw pulleys and attach to the lower corners of the mirror panel as shown. Now join the book-niches unit to the mirror well and add the drawer and cosmetic compartments. The crossrail ties the assembly together at the front.

The top can be of a single plywood panel or built up of $\frac{3}{4}$ -in. solid stock, glued and doweled. A wire hook supports the top in a raised position. Divide the opening for the drawers into three equal divisions and then cut the drawers accordingly to fit flush. Note in Figs. 5 and 6 that the fronts



of the upper two extend to the bottom of the guides, allowing clearance at the hand holes to prevent rubbing. Like the top, the chair back can be of plywood or built up. A padded cushion fitted to the seat will give added comfort. When nested, the back of the chair should come flush with the book niches.

In applying an enamel finish the surfaces must be smooth. This means considerable hand work with sandpaper and a block. Use a medium-coarse grade of sandpaper to start, then finish with a fine grit. It is always better to apply two thinner coats than to risk piling up the undercoater. Sand the undercoater lightly, lay on the first coat of enamel and sand again. The final finish coat should then level nicely in drying.

 $\frac{1}{4}$ " E

LEA

SCREW PULLEY

④ VIEW THROUGH MIRROR WELL

PLYWOOD

CLEATS SAME
THICKNESS
AS GLASS,
CURVED TO
FIT MIRROR

REGULAR
THREE-PANE
MIRROR

15"НООК

WEIGHT

DRAWER DETAIL

NOTCH FOR
CROSS

⑦

VANITY STOOL

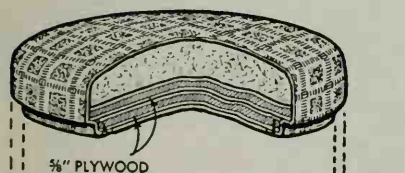
It's actually a 5-gal. paint pail fitted with a padded seat and tailored inside and out with a gay-colored slip cover. Seat lifts off for storing shoes inside



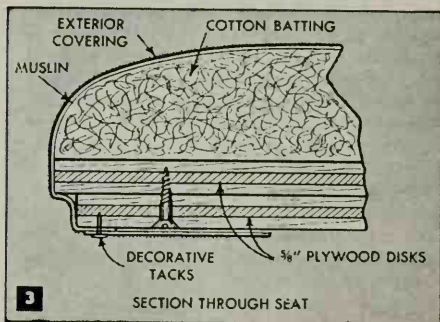
1

UTILIZING a common 5-gal. pail for its framework, this vanity stool is both light-weight and sturdy, simple to make and provides a convenient storage compartment for shoes, hats, etc. Select a pail having straight sides—one in which paint comes will do—remove the handle if it has one, and clean the inside thoroughly by scraping or burning out the old paint.

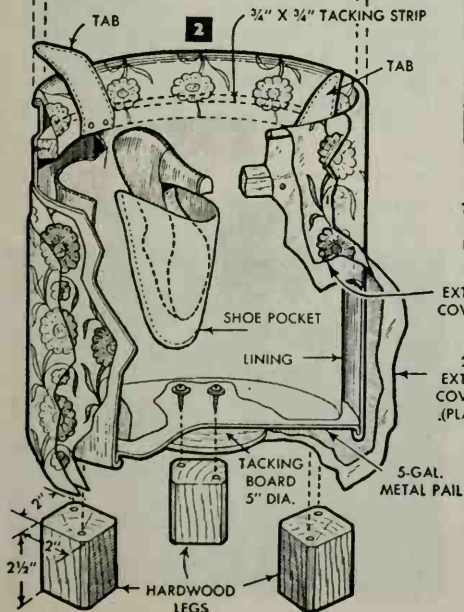
A tacking strip or ring is fitted inside the pail about 2 in. down from the top and is fastened with flathead screws from the outside as in Fig. 2. The ring need not be in one piece—it can be of several segments



2



3



4



as it is hidden from view. Next, the bottom of the pail is drilled for screws to attach the three stub legs. These can be made of fancy hardwood and varnished, or cut from pine and painted. Two 1-in. screws are used to attach each leg. Holes are drilled in the bottom also for fastening a $\frac{3}{8}$ by 5-in. wood disk to serve as a tacking surface for the outer covering. This is located in the center of the pail. The rabbeted edge of the seat board is formed by two $\frac{5}{8}$ -in.-plywood disks screwed together, one being the same diameter as the pail and the other about $\frac{1}{4}$ in. smaller, Fig. 3.

You're now ready to tackle the upholstering. The inside lining is applied first. This can be of a material contrasting with that used on the outside. Make a tubular-shaped bag of it to fit the inside diameter of the tacking ring. If the stool is to be used for shoe storage, pockets should be sewed to the lining before it is tacked in place at the top. The outside covering is likewise sewed in a tubular shape to be pulled snugly over the pail. Fold the upper edge of it under and tack it neatly to the wood ring, forming small pleats where necessary to eliminate wrinkles. After the top edge is tacked, the fabric is pulled down smoothly and tacked to the wood disk at the bottom. Although optional, the outside covering of the stool can be protected from soiling by covering it with any of the transparent plastic materials, tacking it the same as before. See Fig. 4. Finally, two strong tabs of cloth are tacked to opposite sides of the wood ring to provide handles for carrying



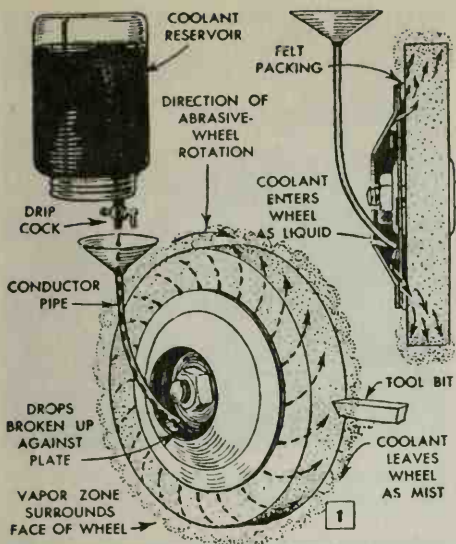
the stool. These should be long enough to extend out from under the seat as shown in Fig. 1. This leaves the seat to be padded as indicated in the cross-sectional view in Fig. 3. Cotton batting is first applied generously and is held in place with a muslin cover. Several thicknesses of foam rubber, available in sheet form, could be used in place of the cotton. The outer covering is brought around and tacked neatly to the under edge and finished with a circular piece. Where the material covers the rabbeted edge it should be tacked to the underside of the top disk.

VAPOR

Vapors of Solvents Utilized For More Economical Use

Solvents, such as lacquer thinner, may be used more economically by utilizing their vapors to remove paint from objects small enough to be placed in an airtight container. The example in the picture shows the paint being removed from the spots on a set of dominoes, preparatory to respotting them. The dominoes were placed in a coffee can, a tablespoonful of lacquer thinner was added and the lid placed on tightly. After 24 hours the paint was soft enough to be wiped off. Other highly volatile solvents may be used in the same way.





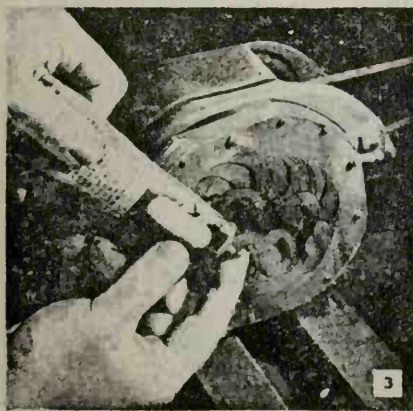
VAPOR-ZONE GRINDING

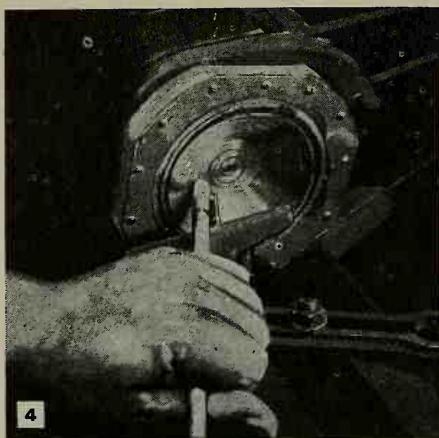
FITTING your bench grinder with a vapor-zone attachment transforms it from a run-of-the-mill shop tool to a highly efficient machine for putting keen, razor-sharp edges on both wood and metalworking tools. Simply by providing a zone of soap-oil vapor which rotates with the grinding wheel, tool-sharpening time is cut in half. As heat is continually dissipated from the cutting edge of the work, the tool remains cool even when heavy cuts are taken. The work can be held firmly with the fingers close to the cutting edge and sharpening completed without quenching in water. The coolant actually reaches the point of contact, burning of the feather edge being minimized as temperatures average 500 deg. cooler than in dry grinding. Danger of altering the work hardness is reduced. In addition, the wheel is washed constantly with less tendency to load, and grinding dust is precipitated in the form of paste.

The vapor-zone attachment operates by restricting the flow of coolant to the point where only an invisible spray emerges from the rim, or face, of the abrasive wheel, Fig. 1. Being light, the vapor is held near the rim by air currents, and whirls around with the wheel until it contacts an object thrust into the air stream. The mist then condenses into droplets, dampening the work but not getting it dripping wet. The most effective coolant, determined by experiment, consists of $\frac{1}{2}$



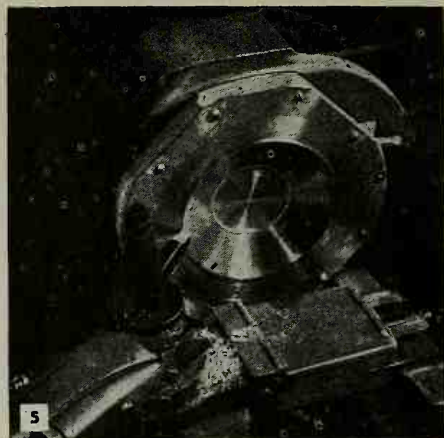
Distributor-cup form is dished-out, above, and brass is lubricated with graphite grease, below





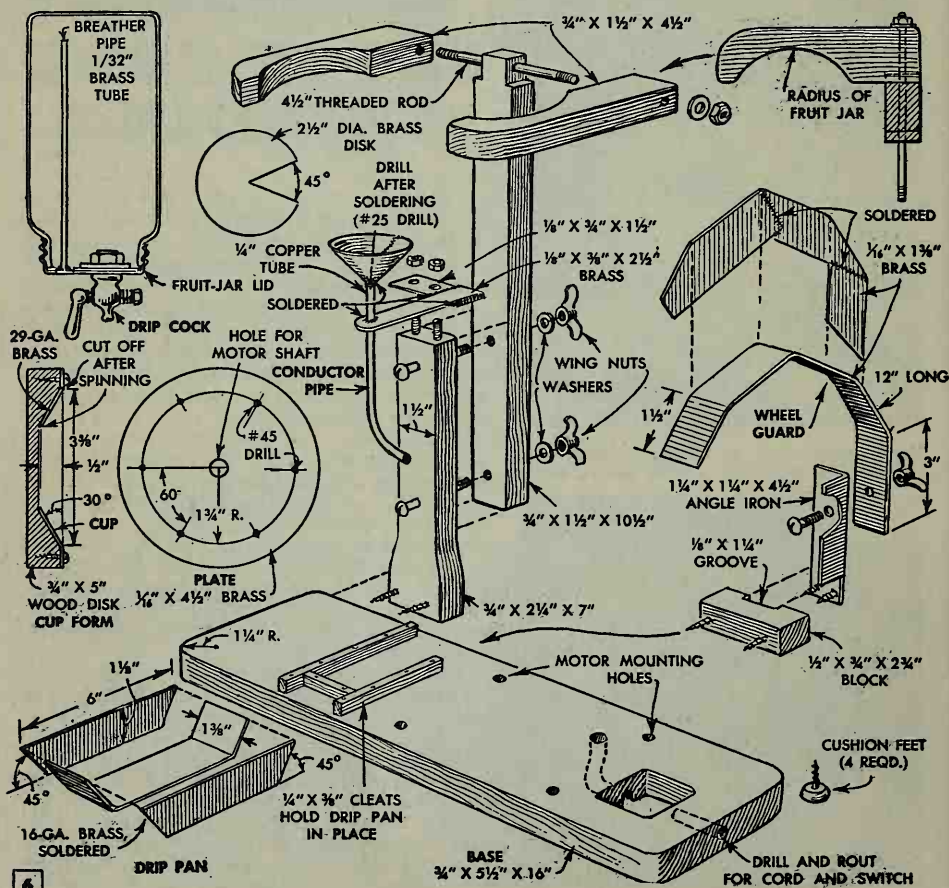
4

Pin clamped to tool rest steadies birch dowel for spinning distributor cup from blank of soft brass



5

Edge of distributor cup is scored on lathe. Then work is unfastened from form and waste cut away



6



Rim of distributor cup is smoothed on emery cloth to assure watertight joint when soldered to brass plate



After brass plate is cut out and drilled, a groove is turned near edge to receive ring of felt packing

teaspoonful of soapless laundry powder dissolved in $\frac{1}{2}$ pint of cold water. To this is added as much vegetable cooking oil as will dissolve when stirred (about 6 or 8 drops) and a pinch of borax. A half pint of this coolant will last for an hour or so, cooling much more efficiently than an equal volume of pure water.

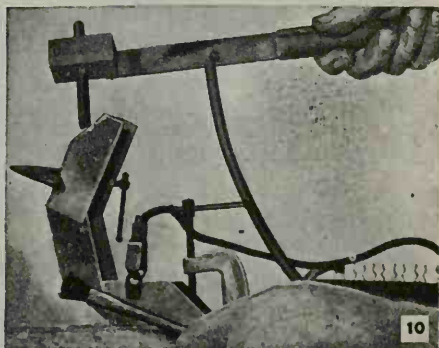
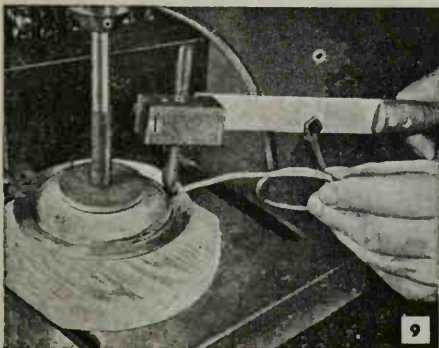
Begin construction of the unit by making the cup-shaped distributor disk which is assembled as in Fig. 1. The cup is spun from soft-drawn sheet brass, using a wooden form as shown in Figs. 2 and 6. The brass is screwed securely to the form and smeared with graphite grease, Fig. 3. Spinning is done with a length of $\frac{1}{2}$ -in. birch dowel, using a pin clamped to the tool rest as a fulcrum against which the dowel is held, Fig. 4. Running the lathe at high speed, start from the center of the work and slowly press the dowel downward and outward. Be gentle, as extreme pressure

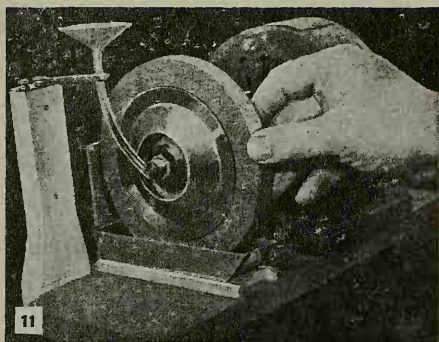
speeds hardening of the brass and may result in a spoiled cup. Continue the stroking action until the metal has "flowed" into the full contour of the form. Then cut away the center section, or bottom, of the cup and carefully score the edge, Fig. 5. Do not cut clear through, because the cup will be damaged when it pulls away. Unfasten the cup from the wooden form and cut along the scored line with tinner's snips. To assure a watertight joint when soldered to a brass plate, the rim of the cup must be lapped smooth on a sheet of fine emery cloth or a lapping plate as in Fig. 7. Cut out and drill the plate, Fig. 6, and true the edge on the lathe. Then turn a groove near the edge for the ring of felt packing, Fig. 8.

The cup and plate must be centered accurately before they are soldered together. This can be done by chucking a pad center in the drill press, using it to center and clamp the parts together. The pad center

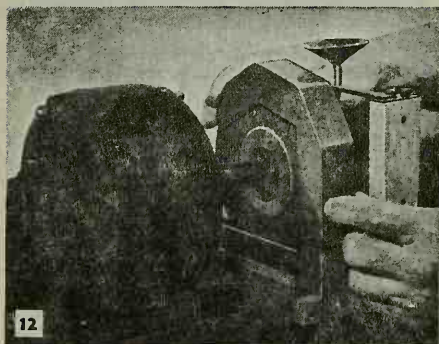
Metal rod chucked in drill press holds disk against cup to provide pad center and clamp for soldering

Carbon-arc soldering machine speeds work and small fiber brush spreads melted solder for neater joints

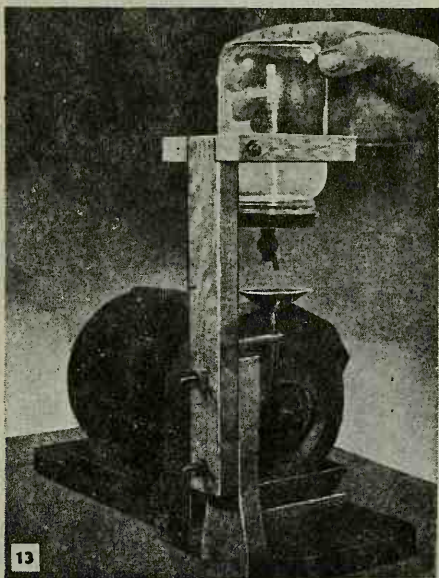




11
Drip pan fits directly under grinding wheel. End of conductor pipe is positioned close to brass plate



12
Wheel guard is attached with wing nut, above, and coolant container mounted on wooden clamp, below



13

is a length of steel rod with a disk fastened to or merely slipped under the free end. Coat the assembly with flux, tack-solder and then flow a wash of solder completely around the joint, Fig. 9. An inexpensive fiber brush, Fig. 10, may be dipped in flux and used to spread the melted solder, resulting in neater joints. If available, a carbon-arc soldering machine will do the job in a fraction of the time required for ordinary methods.

The base, uprights and jar clamp are made from hardwood as shown in Fig. 6, the radius of the clamping arms being determined by the size of the coolant container. A brass drip pan, held in place with wooden cleats, fits directly beneath the grinding wheel to catch the paste formed by the mixture of grinding dust and coolant. The construction of the conductor pipe is detailed in Fig. 6 and its assembly is illustrated in Figs. 1 and 11. The brass hanger supporting the pipe must be detachable, as it is necessary to remove the conductor pipe each time the grinding wheel is changed. For efficient distribution of the coolant, the end of the pipe must fit as closely to the plate as possible, Fig. 1. However, if a large-diameter retaining ing washer is used, consider this as part of the plate when checking the pipe length.

The detachable wheel guard, Figs. 6 and 12, must be substantial for maximum safety, so be sure that the soldered joints are strong. After tack-soldering the parts of the guard, flow solder along the joints. A good soldered joint flows all the way through and there should be a continuous fillet of solder along the inside of each joint.

An ordinary glass jar having a screw-type lid will do for the coolant receptacle. The lid is fitted with a drip cock and breather pipe as in Fig. 6, the drip cock being fastened with a stiffening washer and nut. Select a drip cock that turns easily so minute adjustments can be made. It is an excellent idea to keep two or more jars of coolant on hand. Then, as soon as one jar is empty, the cap can be screwed on the full one and the jar mounted in the clamp as in Fig. 13. Note that the clamp should hold the jar high enough so the drip cock can be regulated easily. Protect the completed unit by painting the parts with waterproof lacquer before assembly.

When using the vapor-zone attachment, allow the grinder to run for a few seconds after the coolant has been turned on and hold your finger close to the face of the wheel. Then, when your finger feels cool and droplets form on it, the grinder is ready for use. Experimenting will determine the proper flow of coolant for a particular job. However, one drop per second is about the average rate of flow.

VARNISH

**LITTLE TRICKS THAT
HELP IN APPLYING A
PERFECT VARNISH FINISH**



DON'T use varnish directly from the can. **DO** pour what you'll need in a separate cup and discard left-overs



DON'T apply succeeding coats of varnish without first testing hardness. **DO** apply succeeding coats when the varnish resists impression of thumbnail

DON'T apply varnish if chilled—it will be sticky and hard to brush. **DO** warm it by setting the can in hot water (70-90°) and it will level nicely



DON'T rub down coats with fresh sandpaper. **DO** scuff it first by rubbing together to knock off the sharp grits



However careful, dirt specks will get in the finish. These are easily lifted from the wet varnish with a clean sliver of wood tipped with a small ball of burnt varnish to which the specks will cling when touched lightly. Don't wait until the varnish is tacky but remove specks as you go. Burnt varnish consists of varnish, 1 part, melted rosin, 6 parts, well mixed. In use, a drop or two is rolled into a small ball between moistened fingers and placed on a stick. As the specks are lifted from the varnish they are kneaded into the ball

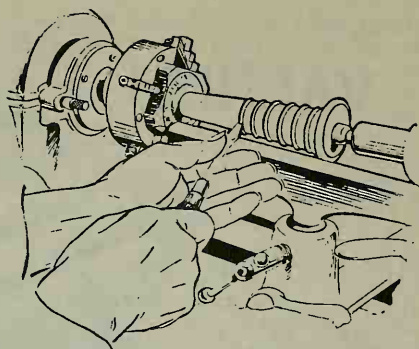


To pick up final traces of dust, the expert uses a "tack rag," which is a cloth moistened with varnish and kept in an airtight can. To make one, dip a cotton handkerchief in warm water, wring out lightly, sprinkle with turpentine and cover with varnish. Wring out until nearly dry

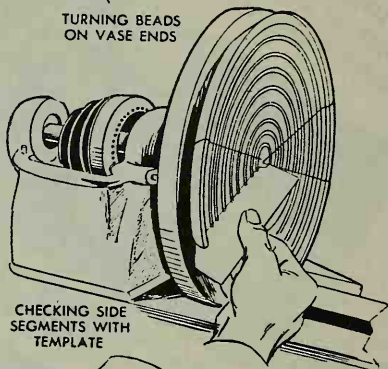


VASES

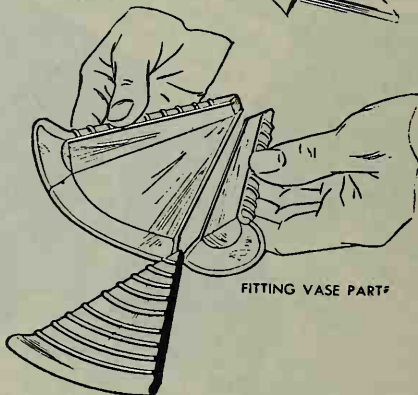
CRAFTSMEN with a liking for tricky lathe projects will find this turned fan vase a fair test of skill. The endpieces of the vase are formed from a split turning having one flared end and uniformly spaced beading along the spindle. After the turning is finished and split apart, the halves are grooved as in the detail below. The sidepieces are segments of a built-up disk which is turned on the faceplate. A tenon is cut on the edges of each piece, and then the four members of the vase are glued together. After the glue is dry the vase is mounted in the lathe, as in the lower right-hand detail, and a tenon is turned at the lower end to fit into a hole drilled in the base. The latter is turned to the dimensions given in the detail below.



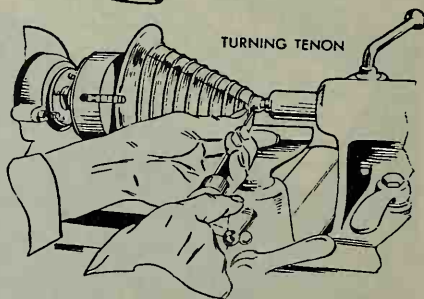
TURNING BEADS
ON VASE ENDS



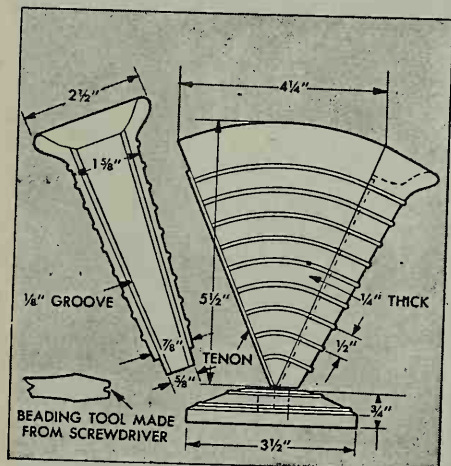
CHECKING SIDE
SEGMENTS WITH
TEMPLATE



FITTING VASE PART



TURNING TENON



VEGETABLE STORAGE

"WARM" VEGETABLES
50 DEG. OR HIGHER

SQUASH
PUMPKIN
SWEET POTATOES
BEANS
PEAS

①

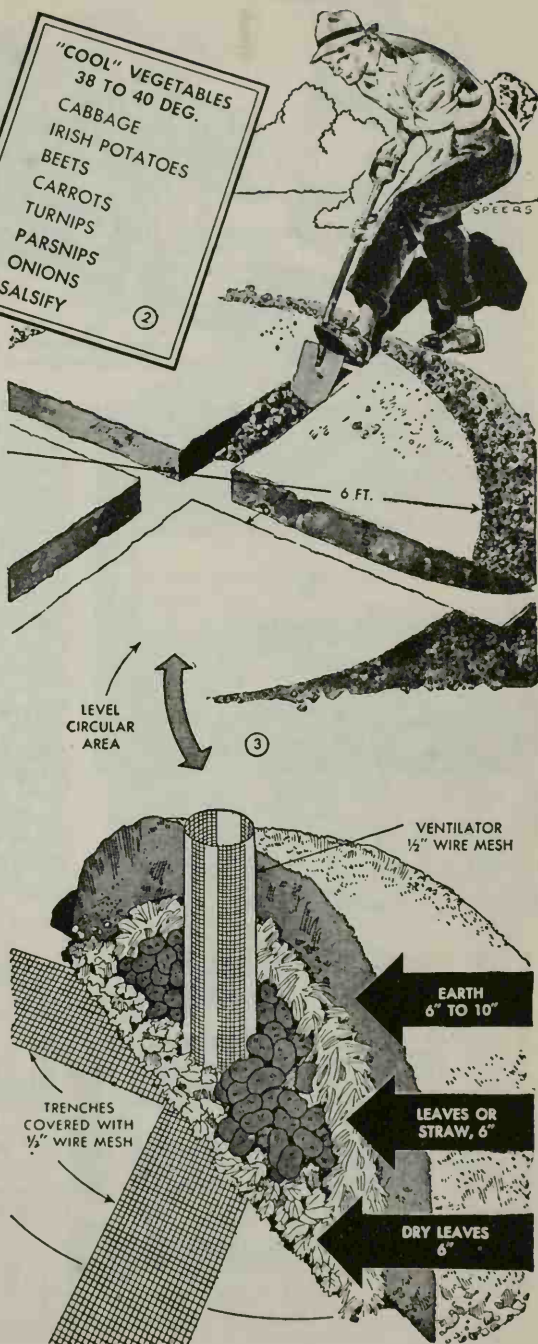
"COOL" VEGETABLES
38 TO 40 DEG.

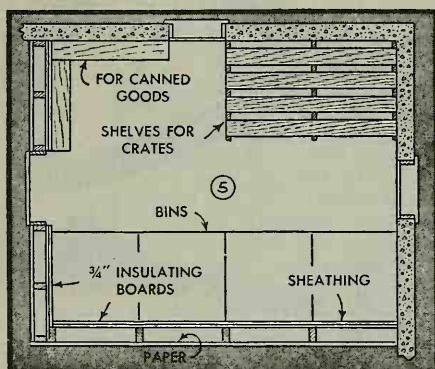
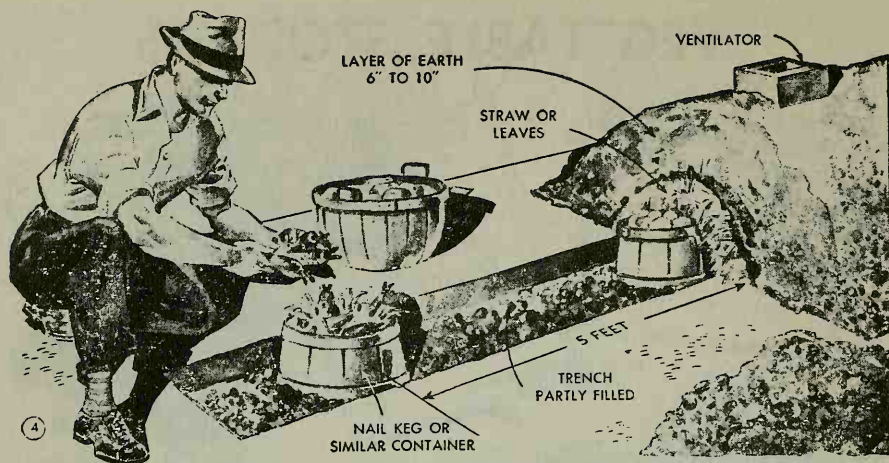
CABBAGE
IRISH POTATOES
BEETS
CARROTS
TURNIPS
PARSNIPS
ONIONS
SALSIFY

②

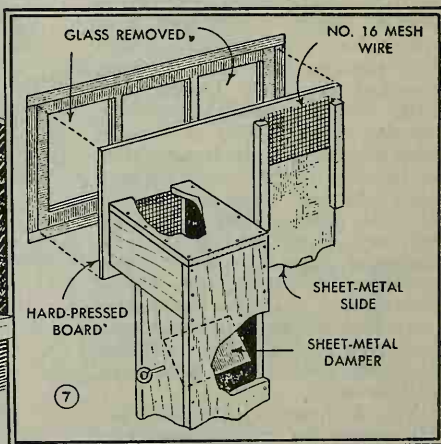
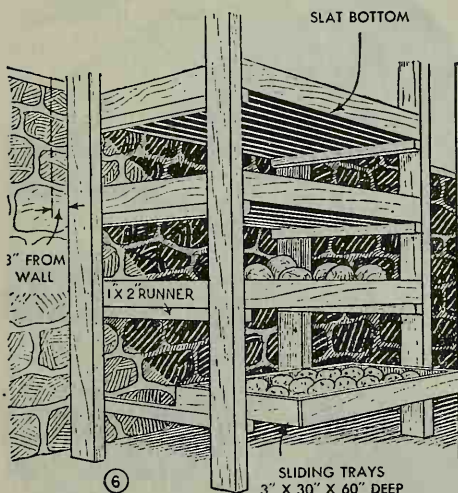
WHEN storing vegetables there are three essentials to safe keeping: quality, temperature and humidity. None but sound vegetables of first quality should be selected for storing. Figs. 1 and 2 list the principal "warm" and "cool" vegetables. Those in Fig. 2 keep best when stored at a temperature of 38 to 40 degrees F. and under conditions of relatively high humidity. Temperature is controlled more easily than humidity. It is difficult to maintain the proper temperature and humidity in the average home basement for "cool" vegetables while "warm" varieties will generally keep very well under these conditions. One good plan for storing the "cool" vegetables, particularly the root crops, potatoes, beets, carrots, and so on, is in an outdoor mound made as shown in Fig. 3. Select a high spot from which there is good drainage, level a circular area and dig cross trenches as shown. Cover these with wire if available, or with wooden slats. A wire or wooden ventilator should also be provided. A wooden one is made square, from 1 by 6-in. stock and a series of $\frac{1}{2}$ -in. holes are bored through each side. Place the vegetables on leaves or straw in a conical pile not more than 30 in. high. Cover as indicated, but leave the ends of the trenches open until lower temperatures during winter make it necessary to close them with straw and earth.

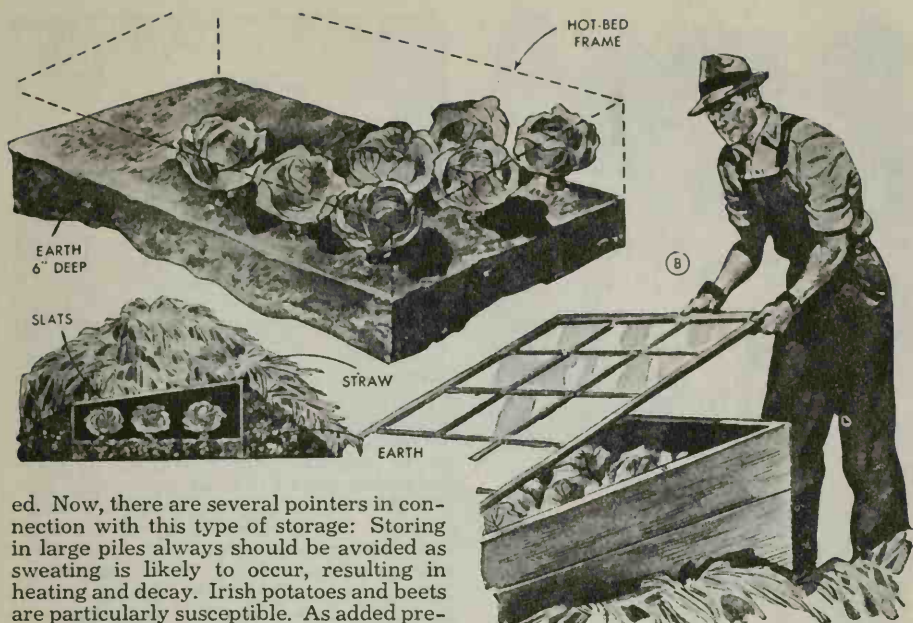
Fig. 4 shows an excellent arrangement for storing vegetables in separate containers from which





a quantity can be removed as needed without disturbing the rest. The details are self-explanatory. Any number of containers can be used. If suitable kegs are not available, bushel baskets will serve. If sand is obtainable, use it to fill the trench. Similar arrangements are shown in Figs. 8 and 9 and 12 and 13. Figs. 8 and 9 show use of a hotbed for storage of cabbage and celery. In each instance remove the original soil and compost or manure bottom from the hotbed. The cabbage heads are pulled roots and all and "planted" in fresh soil as indicated. Only the roots need be buried. Then, cover as indicated. Celery, Fig. 9, may be kept in the same way. In Figs. 12 and 13 the vegetables are stored in a barrel placed in a shallow pit which has been partly filled with sand. The end of the barrel is only partly closed as indicated. When an opening is left in the earth covering in the earlier months no vent is need-

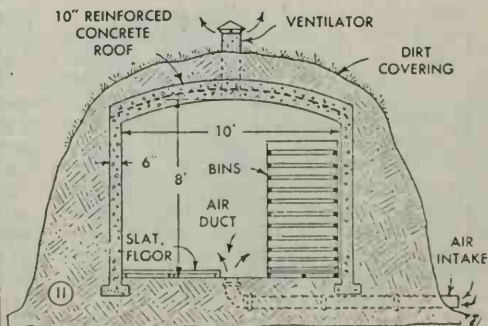
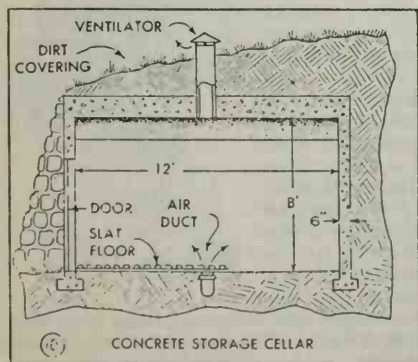


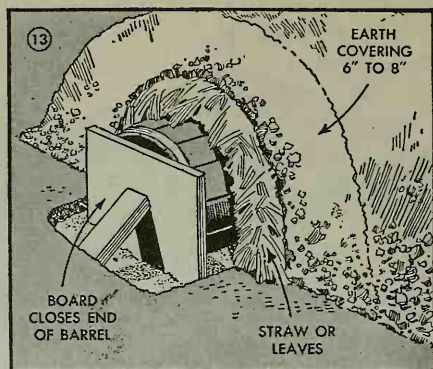


ed. Now, there are several pointers in connection with this type of storage: Storing in large piles always should be avoided as sweating is likely to occur, resulting in heating and decay. Irish potatoes and beets are particularly susceptible. As added precaution in any form of mound storage, dig a shallow drainage ditch around the mound. Tops of the ventilators should always be covered to prevent entrance of rain and snow. The next best thing to the mound storage of small quantities of cool vegetables is a basement storage room built in a corner as detailed in the plan view Fig. 5. Dimensions can be whatever is desirable, but 10 by 12 ft. is a good average. When the floor is concrete you have the problem of humidity, but this can be at least partially solved by waterproofing the "sills" of the two walls and covering the floor with a half and half mixture of sand and peat moss to a depth of about two inches. This should be kept damp at all times. Walls should be tight clear to the sub floor to exclude dry air and heat from



9 CELERY STORED IN HOTBED





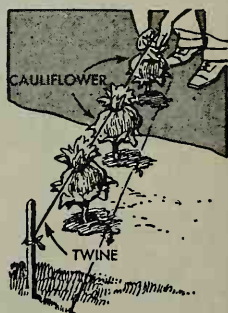
the furnace room. Paint all window glass black or cover with black paper to exclude light. Fit a ventilator over one window as in Fig. 7. The intake duct, the lower one, exhausts air at a point about 10 in. above the floor and is fitted with a swinging damper. If sheet metal is not available for these parts use box boards or wall board. Both inlet and outlet should be covered either with wire or closely spaced slats. With this arrangement it is possible to control both temperature and humidity with a fair degree of accuracy. A handy bin arrangement is shown in Fig. 6. The sliding trays make cleaning easy and during the summer they can be removed and stacked and the space used for other purposes.

Figs. 10 and 11 detail a more pretentious structure of a permanent type to be built into a hillside or on high ground from which there is drainage in all directions. Walls, roof, and ends are of reinforced concrete but the floor is of earth. This type of structure results in good storage conditions for vegetables, particularly root crops. It is always better to store the cool vegetables in shallow bins with slat bottoms than in baskets or barrels. However, where either of the latter must be used, the wooden barrel is usually best. A number of $\frac{3}{4}$ -in. holes bored through the barrel staves near the bottom will aid air circulation. Pumpkins and squashes usually will keep well

in a dry, well ventilated basement, or anywhere in the house where there is no danger of freezing. They should not be piled but rather placed in rows on a shelf. The attic floor is generally a good place to keep peas and beans, after curing on the vine. Pick pole beans as soon as they are mature and spread the pods to dry on the floor. Bush beans are generally allowed to mature on the vine, then the whole plant is pulled and allowed to cure much like hay. After thorough curing the beans are thrashed out and stored in bags hung in a dry place. Sweet potatoes can be kept fairly well in a mound, but a warm, dry place is preferable. In all the methods of mound storage detailed it should be remembered that where the temperature is likely to fall to zero F, or below, the covering of earth and straw will need to be built up to a somewhat greater thickness than that indicated, perhaps a foot or more in the colder climates. If loose earth tends to wash off the mound, cover it with roll roofing or sisal paper.

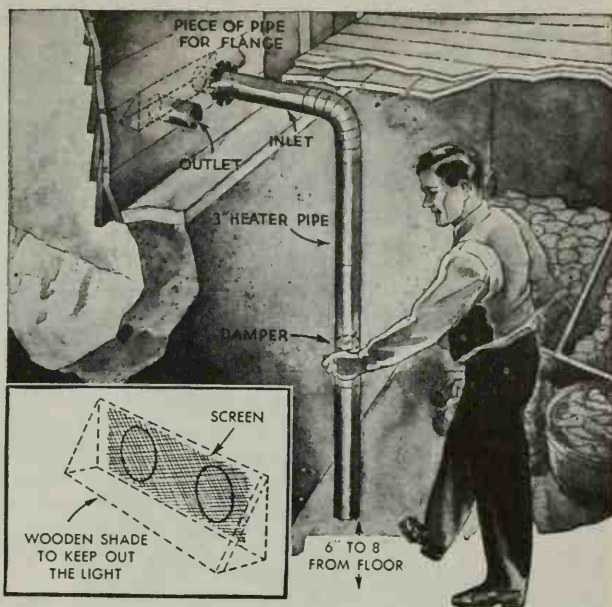
Easy Way to Blanch Cauliflower

Here's an old gardener's tip to blanch cauliflower heads so they will be tender and evenly colored. To do this, run a length of twine between two stakes so that it may be looped once around the gathered outer leaves of each plant, thus enclosing the heads and sheltering them from the rays of the sun. This should be done when the heads are about $1\frac{1}{2}$ to 2 in. in diameter.



Winter Air Refrigerates Vegetable Storage Room

Safe storage of vegetables in a basement requires that the storage room be kept as cool as possible, and that proper ventilation and humidity be maintained. To approximate this condition in the average home, the owner can bring cool air in from the outside by means of a 3-in. sheet-metal heater pipe as shown. The pipe should extend down to within 6 to 8 in. of the floor, and a short outlet pipe should be provided as indicated to permit air circulation. A damper in the inlet pipe permits regulation of the incoming air to prevent freezing inside the storage room during extremely cold weather. As the storage room should be dark inside, a shade is fitted over the ends of the pipes where they pass through the outside wall. This is merely a triangular box having the underside open. Screen wire over the ends of the pipes keeps out insects. Of course, the storage room should be tight to

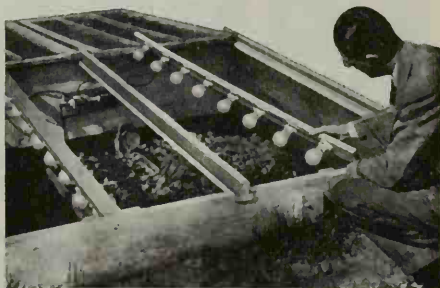


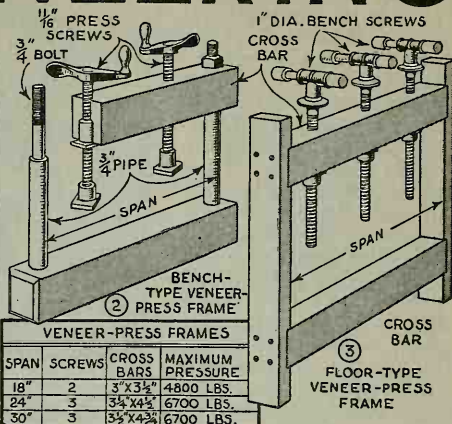
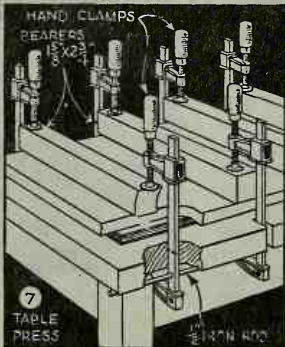
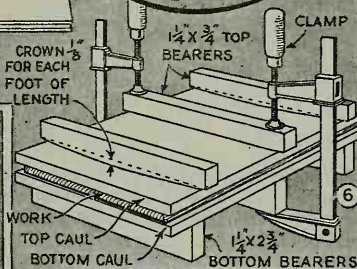
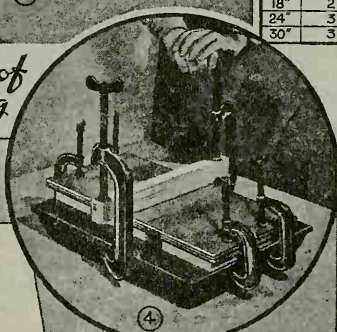
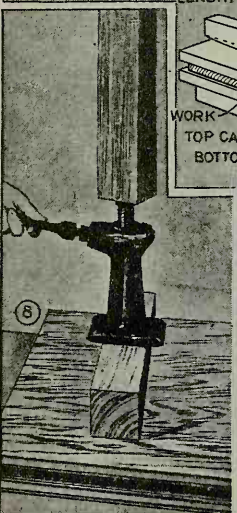
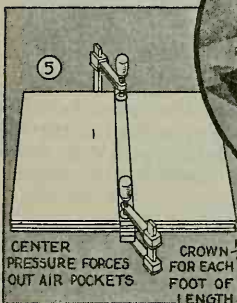
keep cold air from entering the rest of the basement. If possible, the room should be insulated. This can be done inexpensively by lining it with $\frac{1}{2}$ -in. insulating board, which is available at your lumber yard.

Heat From Light-Bulb Clusters Speeds Seedling Growth

Hotbeds heated by clusters of 25-watt light bulbs hurry vegetables to your table 10 days to two weeks ahead of ordinary outdoor plantings, as vigorous seedlings from heated hotbeds are already well-rooted individual plants when transplanting time arrives. Using the same method of heating, certain flowering plants can be made to produce profuse blooms four weeks earlier than normal. Build the hotbed frame and the seedbed in the regular way, then construct individual heating units by attaching eight porcelain sockets to a length of 1 x 4 which will span the hotbed frame across its width. One heating unit is required for an area 3 x 6 ft. An average-size hotbed frame 6 x 6 ft. would require two units. The units are wired to a common outlet and are controlled by a bulb-type thermostat placed just below the surface of

the soil. The thermostat is set to turn on the lights when the temperature in the hotbed falls below 50 deg. F.

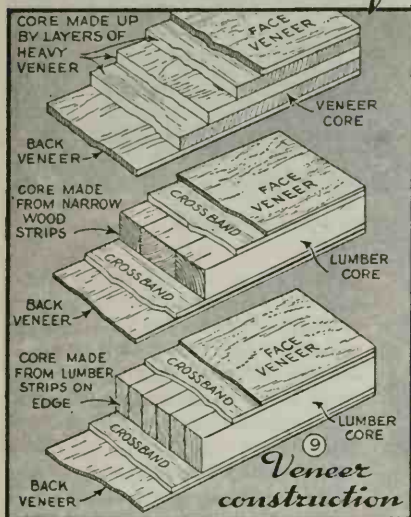




SPAN	SCREWS	CROSS BARS	MAXIMUM PRESSURE
18"	2	3" X 3 1/2"	4800 LBS.
24"	3	3 1/2" X 4 1/2"	6700 LBS.
30"	3	3 1/2" X 4 3/4"	6700 LBS.

Construction of veneer-press frames is given in the drawings, while the table shows the required dimensions of the cross bars to resist a given pressure. The wood used should be maple or yellow pine. Where a greater span is desired, the cross bars can be stiffened with iron plates. Fig. 2 shows a two-screw bench frame, while Fig. 3 shows a press of sufficient depth to be used on the floor, several of which are being used as a unit in Fig. 10. Fig. 4 shows how a surface plate or machine-table

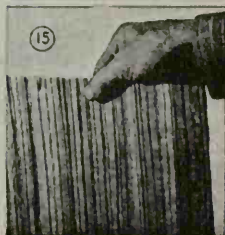
Increases Scope of Craftwork

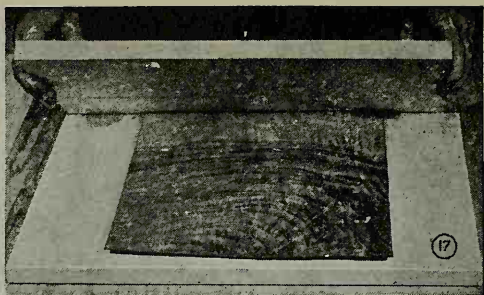
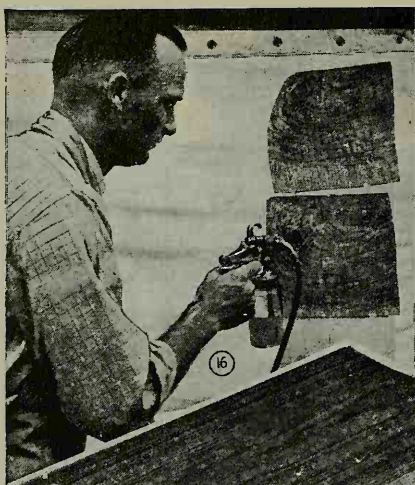


top can be used as a base for clamping. The standard set-up for clamping with bearers is given in Fig. 6. Note that the top bearers are not straight but are slightly curved on the underside. How the bearer method of clamping is used in making a permanent table press is given in Fig. 7. Excellent work can be done by using an automobile jack, Fig. 8, pushing against a heavy ceiling joist. After applying pressure in the center, the edges of the work are held by means of hand clamps. In any method of clamping, center pressure must be applied first, Fig. 5. This forces air pockets and excess glue to the edges of the work.

Veneer construction: Three of the commonest methods of constructing veneer panels are shown in Fig. 9. All are known as plywood. The center portion of the panel is the core. Lumber core plywood has a core of solid lumber strips. These are covered by a veneer called the crossband, and the crossbands are then faced with the face and back veneers. In all forms of construction, the grain of each layer is at right angles to the grain of the layer under it.

Making a lumber core: Plywood with either a veneer or lumber core can be purchased and needs only the application of face and back veneers to complete it. If the worker should wish to make his own core, the principles of core construction are illustrated in Figs. 11 to 14. Fig. 11 shows how lumber shrinks—always bowing out on the heart side. As a sheet of veneer has a tendency to pull the work hollow, it follows that where one face only of the core is to be veneered, the veneer should be applied on the heart side. This side is distinguished readily by inspecting the end grain, Fig. 12. To further eliminate warping, the lumber is usually ripped into narrow strips 3 to 4 in. wide, reversing every other piece end for end so that the heart side is alternately up and down, Fig. 13. Lumber cores always should be cross-banded, the best lumber for both cores and crossbands





Flattening veneers

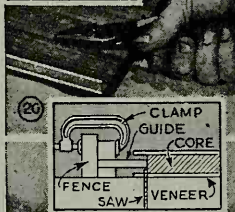
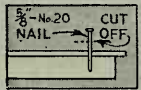
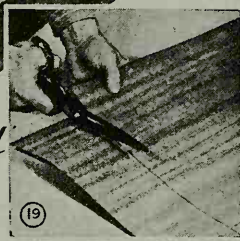
coat is essential, and is always applied to the core, not to the veneer.

Flattening veneers: Veneers are normally flat, and if kept between boards will stay that way. Intricate graining in burls and butts, however, tends to warp the veneer, and the piece must be straightened before it can be applied. Various preparations are available for this purpose, and can be applied by brush, dip, or spray, Fig. 16. When the surface wetness has dried, the veneer is placed between boards, Fig. 17, for overnight drying. A good glue size for flattening can be made by mixing, by weight, casein glue, 1 part, water, 4 parts, and then adding slowly alcohol, $2\frac{1}{2}$ parts and glycerine, $1\frac{1}{2}$ parts.

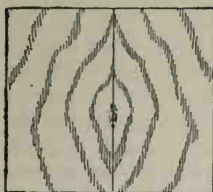
Assembling a panel

being poplar. Veneer cores need not be cross-banded as the top layer of veneer is itself a cross-band. Face veneers should be applied with the right side out whenever possible. The right or "tight" side can be determined by rubbing the surface of the veneer with the fingers, as in Fig. 15, the right side having a slightly smoother grain.

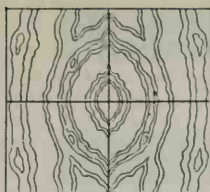
Concerning glue: Casein glue is used for most homecraft veneering. It is in dry powder form and requires only mixing with water to make it ready for use. Cold resin glue is also excellent. Both types should be applied with a brush having fairly stiff bristles. An even



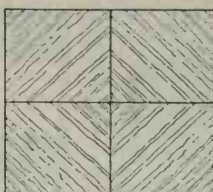
Assembling a panel: A panel with one-piece faces on a veneer core is shown in Fig. 18. The face and back veneers can be cut with a knife, saw, or heavy scissors, Fig. 19, and should be about $\frac{1}{4}$ in. larger all around than the core. Glue is brushed on one side of the



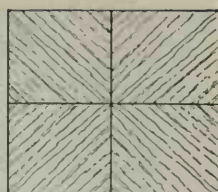
TWO-PIECE MATCH (22)



FOUR-PIECE MATCH (23)



DIAMOND MATCH (24)



REVERSE DIAMOND (25)

core. The veneer is applied and is pressed down smoothly with the hands, stroking from the center to the edges. To prevent slippage, the veneer is held in place by small brads or nails. The heads of these are cut off about $\frac{1}{8}$ in. above the surface, as shown in Fig. 20. Then the work is turned over and the veneer applied in the same manner to the opposite side. Place a double sheet of newspaper over each side to catch any glue seepage, or, use waxed cauls. Place the work between the cauls, applying pressure by hand so that the brads enter the cauls. Then put the work in the press and apply pressure. Work should remain in the press from 3 to 6 hrs. After removal, the overhanging veneer edges can be trimmed off. The pattern method of cutting on the saw, Fig. 21, gives a very clean edge.

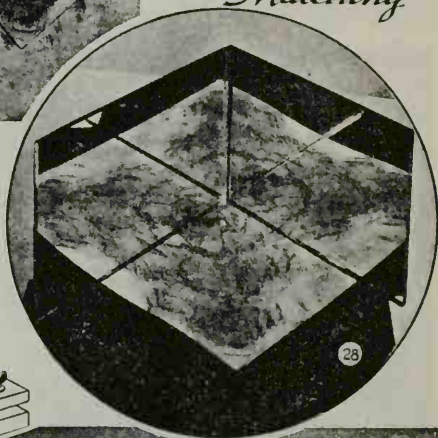


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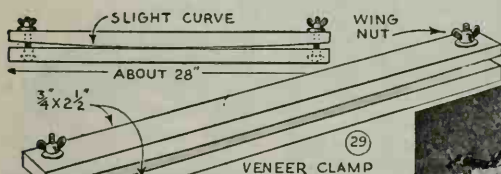


(27)

Matching

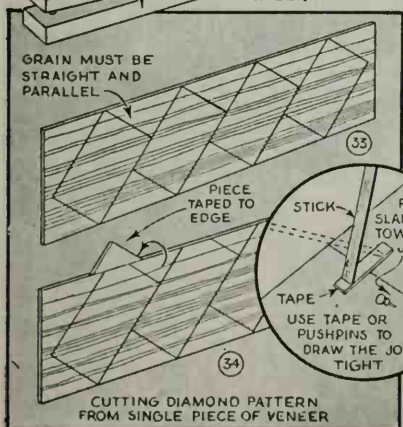


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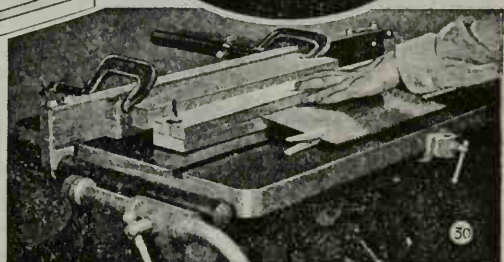


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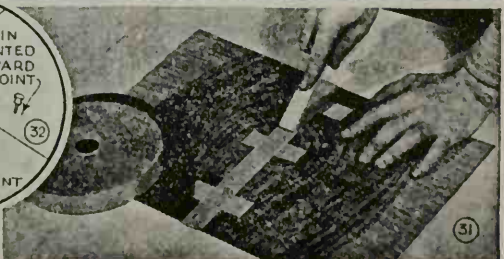
VENEER CLAMP



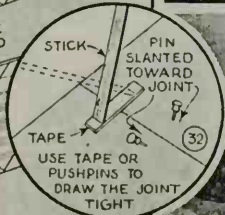
CUTTING DIAMOND PATTERN FROM SINGLE PIECE OF VENEER



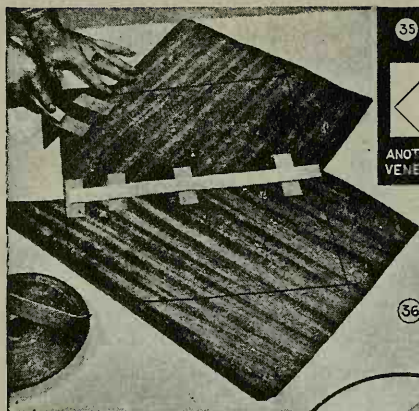
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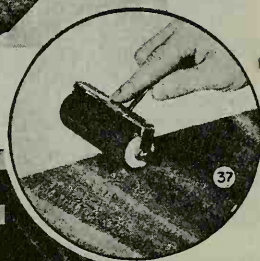
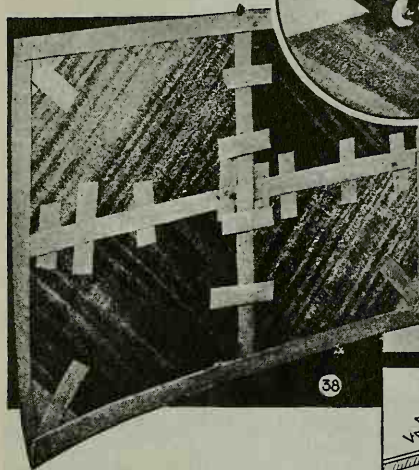
(31)



(32)



Forming a diamond match

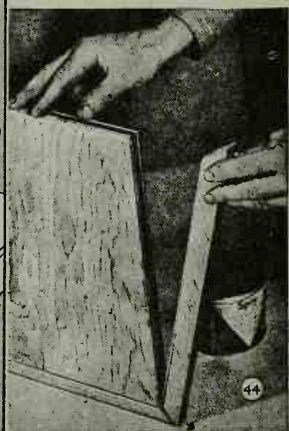
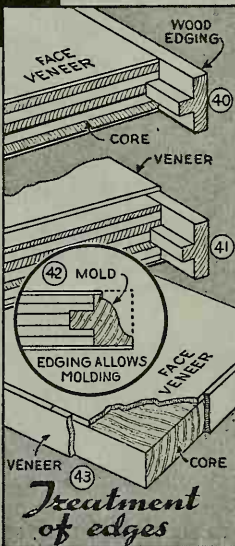
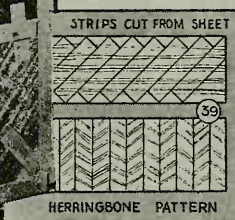


Matching: Veneer faces are not always in single widths but are often made up of two or more pieces. Frequently the various pieces are matched to form pleasing figures, a few examples of which are shown in Figs. 22 to 25. The two-piece match requires two identical consecutive sheets of veneer, while the four-piece match requires four identical pieces. Diamond patterns can be cut from either consecutive sheets or from a single sheet. In developing four-piece figures, a pair of small mirrors can be used to advantage. Fig. 26 shows one sheet of four

consecutive sheets. The appearance of any area on this sheet in a four-piece match can be observed by covering two edges of the area with paper, Fig. 27, and placing the mirrors on the other edges, as shown in Fig. 28. Moving the paper and mirrors around will reveal the most pleasing figure.

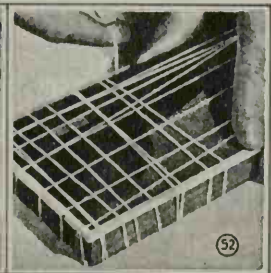
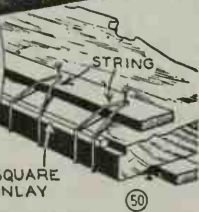
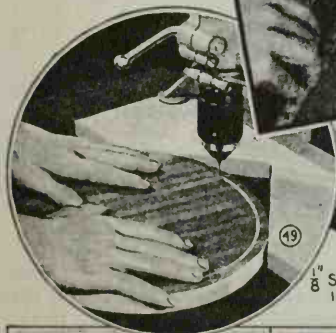
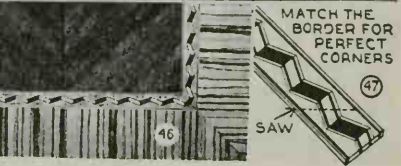
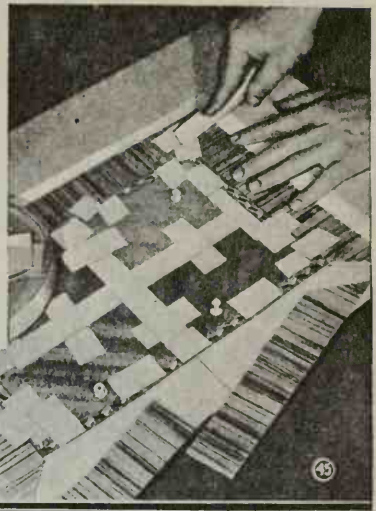
In jointing veneers edge to edge, it usually is necessary to hold the two sheets of veneer in a suitable clamp, as shown in Fig. 29. About $\frac{1}{8}$ in. of veneer should overhang the edge of the clamp. Jointing can be done with a plane, a jointer, with sandpaper glued to a length of wood, or by pattern sawing. Pattern sawing, Fig. 30, is similar to the procedure used for trimming edges. After jointing, the two sheets are opened up bookwise, and assembled with gummed-paper, Figs. 31 and 32.

Making a diamond pattern: How the four pieces for a diamond pattern can be cut from a single sheet of veneer is given in Fig. 33. Fig. 34 shows how the length of the panel can be increased by patching. Fig. 35 shows another method of cutting, employing two consecutive sheets. The assembly of a diamond cut in this manner is shown in Fig. 36.



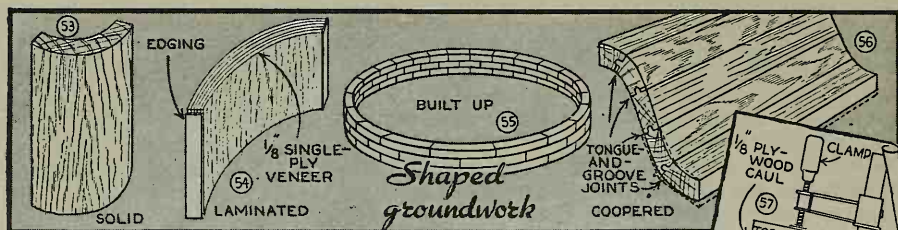
Two consecutive sheets of veneer will give a perfect match at one joint, while the other joint will be an approximate match depending on the continuity of the grain. Mahogany gives almost perfect results even when all four pieces are cut from the same sheet. After each joint has been taped, the edges can be folded back and glue applied with a small roller, Fig. 37. Fig. 38 shows the completed diamond pattern, ready for the press. The herringbone pattern, Fig. 39, is made much like the diamond except every other piece is turned over.

Treatment of edges: The edges of a lumber-core panel require no treatment and can be molded and finished the same as a solid piece of wood. Edges of veneer cores are frequently finished dark with burnt umber to conceal the layers of veneer. A better method is to use an edging of the same wood as the face veneer, as shown in Figs. 40, 41, and 42. The edging can be applied either before or after the veneer is laid, the neatest method being to veneer over the edging. The strips should be mitered neatly at the corners, Fig. 44. Where the edges of the core are veneered, Fig. 43, the end grain of the core must be well sized with glue.

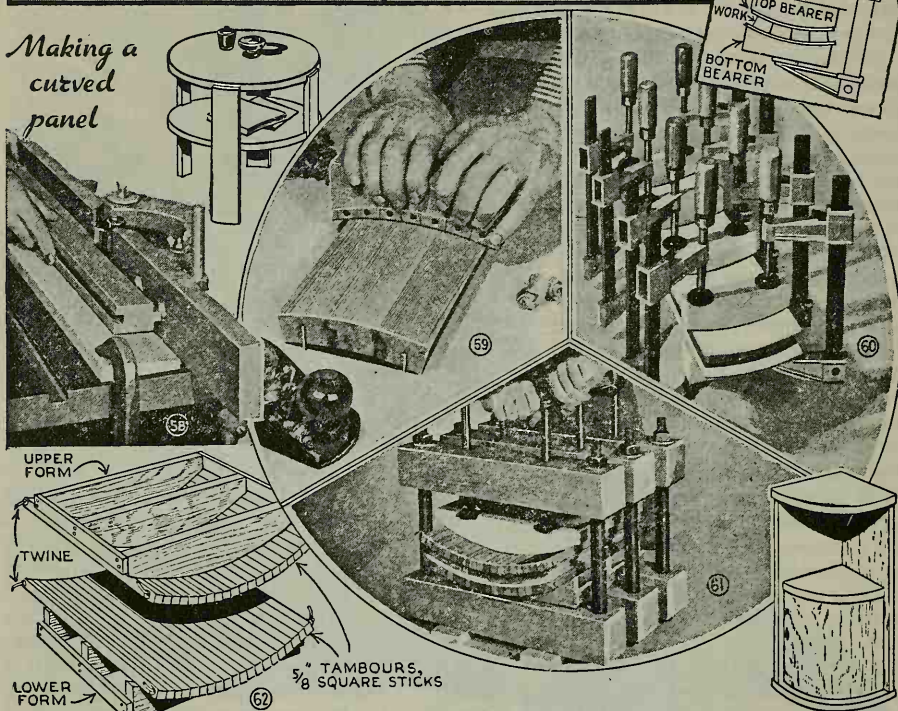


Inlay bands and borders: Inlay bands are available in a variety of widths and patterns in lengths of about 40 in. Usually, the banding is taped together with the veneers previous to gluing. Fig. 45 shows a typical panel comprising a mahogany diamond with banding and border being assembled. The work is done on a full-size paper pattern. Push pins or dabs of glue can be used to hold the pieces in place. Both the banding and border should be matched at the mitered corners by matching two pieces as in Fig. 47, and then mitering. Holding the two pieces in the same position, the joint is cleaned up by sanding, Fig. 48. The border strips are cut across the grain from a suitable piece of veneer. Then adjacent strips are placed together so that the grain matches, after which the corner is mitered and sanded. Fig. 46 shows the finished panel.

Very narrow bandings are often laid in a groove routed in the veneered surface, Fig. 49. Glue is



Making a curved panel



applied to the banding, which is then pressed into the groove, as in Fig. 51. It should fit tightly and project slightly above the surface so it can be sanded flush after the glue has dried. Lengths of square inlay, commonly called strings, frequently are inlaid at the edges of a veneered surface. They can be held in place by wrapping with string, Fig. 52, or by the method shown in Fig. 50.

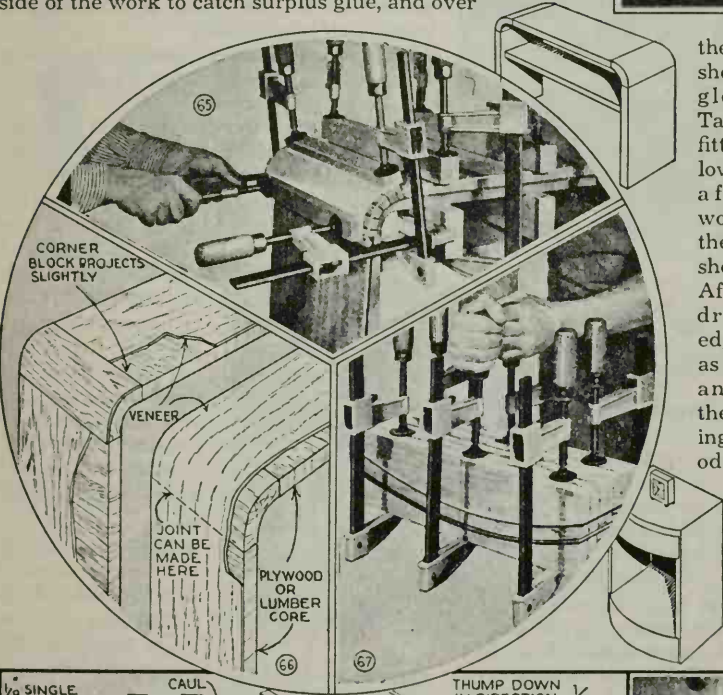
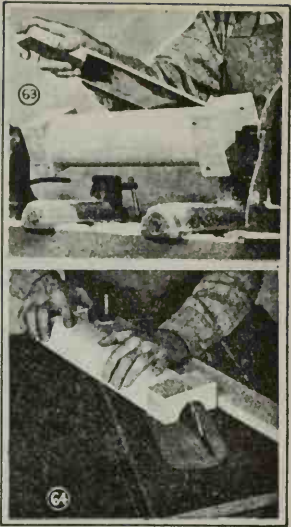
Shaped groundwork: Curved surfaces over which veneer is to be laid can be made by using one of the four methods shown in Figs. 53 to 56 inclusive. Small work usually can be cut from solid stock, as in Fig. 53. Laminating, Fig. 54, is ideal for large work. The built-up or bread-and-butter groundwork is made easily and has the advantage that scrap cuttings can

be cleaned up and used as cauls. Coopered curves, Fig. 56, are a standard method of working, excellent in structural soundness but demanding considerable handwork.

Making a curved panel: The groundwork is made first, using soft wood such as poplar or white pine. Construction will depend on the nature of the work. In the case of a table leg curved across the face, a coopered groundwork would be suitable. A full-size paper pattern is made to show the number of pieces required and the angle at the joints. The pieces are then cut on a shaper, Fig. 58, and assembled with glue. Handwork with sandpaper tacked to shaped blocks, Fig. 59, is the most practical method of securing a finished surface. The work can now be veneered. Both cross-banding and veneer are used in first-

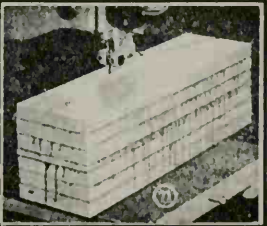
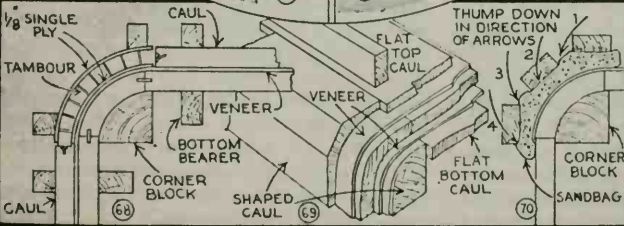
class work, but good results can be obtained with veneer only. A simple method of clamping the veneer in place is shown in Figs. 57 and 60. Thin cauls of $\frac{1}{8}$ in. plywood are used, together with curved bearers.

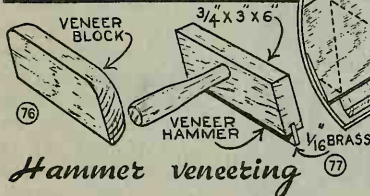
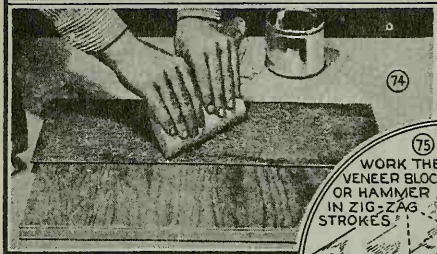
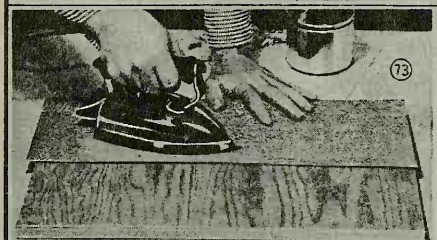
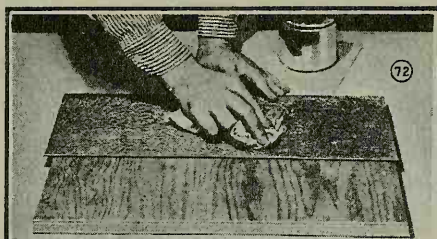
Another example of curved work, a paneled door, is shown in Figs. 61 and 62. This features a laminated groundwork, and is one of the best methods of handling the job. Two pressings are required, one in the assembly of the groundwork and the other in the application of the veneer. Fig. 62 shows the method of working. Three or more lower bearers are band-sawed to the required curve and are held together with wood strips to make a form. The upper form is made in the same manner. Tambours, which are $\frac{5}{8}$ -in. square sticks held loosely together with twine, are used in place of cauls. The five or more layers of single-ply $\frac{1}{8}$ -in. poplar or basswood veneer for the core are glued up, glue being spread on both sides of each piece. The pieces are assembled with the grain in all pieces running the same way, and a nail is driven through the complete thickness at the center of each end. A folded piece of newspaper is placed on each side of the work to catch surplus glue, and over



the paper is placed a sheet of $\frac{1}{8}$ -in. single-ply veneer. Tambours are then fitted in place, followed by the forms, after which the work is ready for the veneer press, as shown in Fig. 61. After the work has dried, hardwood edgings are fitted, as shown in Fig. 54, and the panel is then veneered, using the same method as before.

Veneering around a corner: The round corner is widely used in modern furniture construction, a





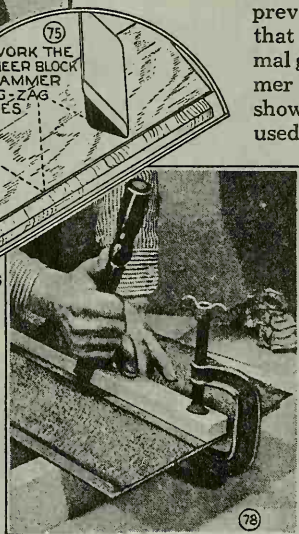
Hammer veneeting

typical example being the bench shown below Fig. 64. The groundwork is prepared by turning and cove cutting, Figs. 63 and 64, after which the curved pieces are tenoned or doweled to flat panels. In a simple method of working, only the flat panels are veneered, as shown in the left-hand detail of Fig. 66. In better work, the veneer runs right around the curve, or is jointed once at the lower edge, as indicated by the dotted line in the right-hand detail. Fig. 65 shows the veneer being fitted around the curve, and Fig. 68 shows the work in cross section. As one side only is being veneered, the corner blocks on the underside are only of such lengths as to accommodate the clamps. Fig. 69 shows another method of

working. In this case both sides of the work are being veneered so the cauls extend completely across the work. A simple way of making the shaped cauls is to band-saw the work in short lengths and then face the curve with a layer of $\frac{1}{8}$ -in. single-ply veneer. This breaks the joints and levels the sawed surface. If more than three short pieces are used to make one caul, the joints should be doweled to obtain stiffness. A sandbag is thumped down around the curve, as in Fig. 70, and is then topped with bearers and clamped.

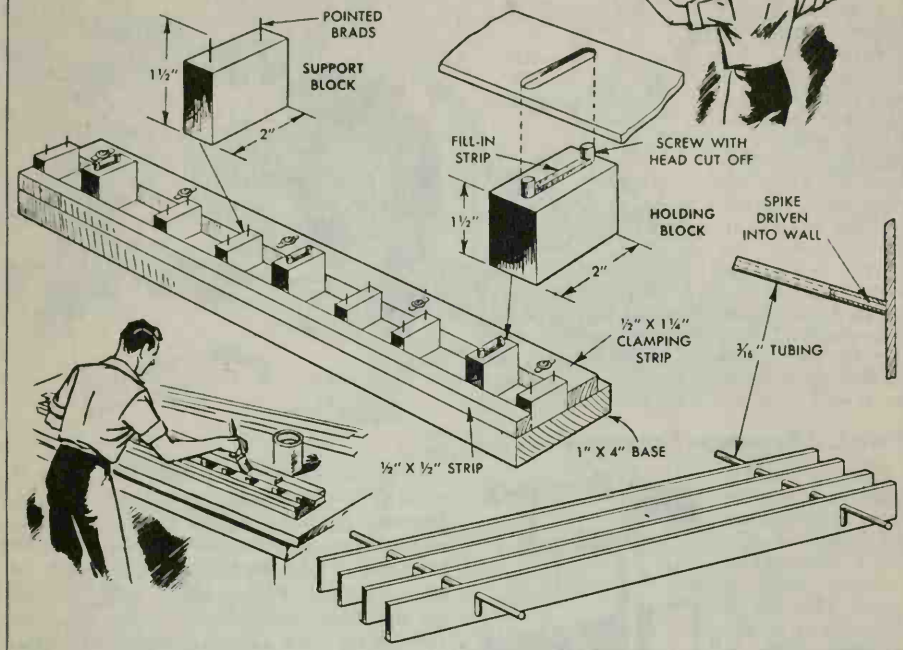
Solid cauls: The groundwork for shaped drawer fronts and similar work is usually made by the built-up method. If the pad is made large, the scrap pieces obtained by band-sawing, Fig. 71, can be used as cauls when applying the veneer, Fig. 67. A layer of felt or blotting paper should be used between the cauls and the veneer. The same method can be used when the groundwork is cut from solid stock.

Hammer veneering: Hammer veneering differs from veneering as previously described in that it is done with hot animal glue. The veneer hammer is a block of wood, as shown in Figs. 76 and 77, used to press the veneer in place. In the example shown in the photos, two pieces of veneer are fitted together to form a flat panel. The groundwork and veneer are first brushed with glue. One of the veneer pieces is then fitted in place. After sponging the veneer with water to prevent burning, Fig. 72, the glue is again



application of a warm iron, Fig. 73. The veneer is then pressed in place with the hammer, Fig. 74, with zig-zag strokes as in Fig. 75, so surplus glue is forced out. Second piece of veneer is similarly glued, allowing 1-in. overlap. Joint is cut with a sharp knife, Fig. 78. A light touch with the iron will soften glue so that veneer can be peeled back to remove waste after which surface is damped and hammered.

Refinishing VENETIAN BLINDS



REFINISHING VENETIAN BLINDS

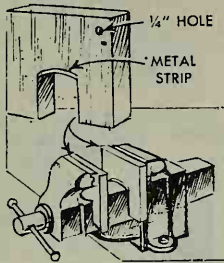
When refinishing Venetian blinds, a great deal of time can be saved by building two racks, one for holding the slats while they are being painted, and another for drying them. To build the painting rack, first cut the base piece, the back strip and the clamping strip to a length which will accommodate the longest slats to be painted. Nail the back strip flush with one edge of the base and cut $\frac{7}{16}$ x $\frac{3}{4}$ -in. slots in the clamping piece at intervals of about 6 inches. Then cut two or three holding blocks, 1 x $1\frac{1}{2}$ x 2 in., one for each cord opening, in the longest slat. Center the opening of a slat over the top of each holding block and, using a sharp pencil, trace a pattern of the opening onto the blocks. These patterns will serve as guides for driving screws which, when the heads are cut off, engage the cord openings of the slats. The screws, of a diameter slightly less than the width of the patterns, are driven just inside the ends of the patterns and extend about $\frac{1}{4}$ in. above the tops of the blocks. After cutting the heads off all screws, place the holding blocks on the

base piece, one at each end and one in the center, with their edges against the back strip. Place the clamping strip in front of the blocks, holding them securely against the back strip as shown. With the clamping strip in this position, drive a round-headed screw through the center of each slot and into the base, seating the head of each screw on a metal washer. Note that the clamping strip can be moved back and the blocks can be adjusted simply by backing off these screws. Now lay a slat in position on the fixture, and fill the space between the headless screws on each holding block with wood putty. The support blocks are made by driving two brads into the top of each block and cutting them off so that the height from the bottom of the block to the top of the brad is $1\frac{1}{2}$ in. Support blocks are spaced 10 inches apart in the fixture. Provide a drying rack for the painted slats by driving two spikes into the wall, spacing them the same distance apart as the outer cord openings of the slats. Cut the heads from the spikes and press a 12-in. length of $\frac{3}{16}$ -in. tubing over each one. Hang the slats in the wall rack as in the lower right-hand detail.

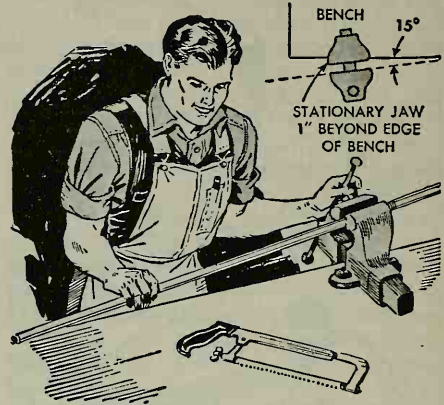
VICES

Auxiliary "Jaws" on Machinist's Vise Prevent Marring Wood Surfaces

In order to use a machinist's vise for woodworking, one craftsman made wooden facing blocks for the jaws. A little wider than the jaws and a snug fit over the vise slide, they protect the work from damage by the metal jaws. The facing blocks should be made of hardwood or hardwood-faced plywood. A metal strip is inserted as shown in the diagram to protect the face block from the slide. A hole drilled in each block allows it to be hung on a nail near the vise when not in use.

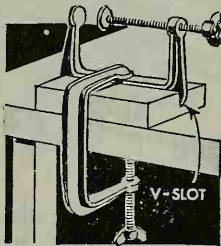


How to Mount Your Bench Vise To Make It More Useful



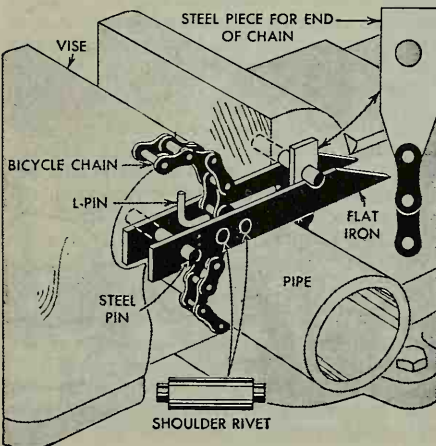
Two C-Clamps as Emergency Vise

Here's a quickly rigged vise for the home modelmaker that requires only two C-clamps and a small block of wood. The wood that acts as a base is notched to fit the back of one of the clamps and the other clamp serves to hold it and the wood in place. The vise can be used for light and small work only.



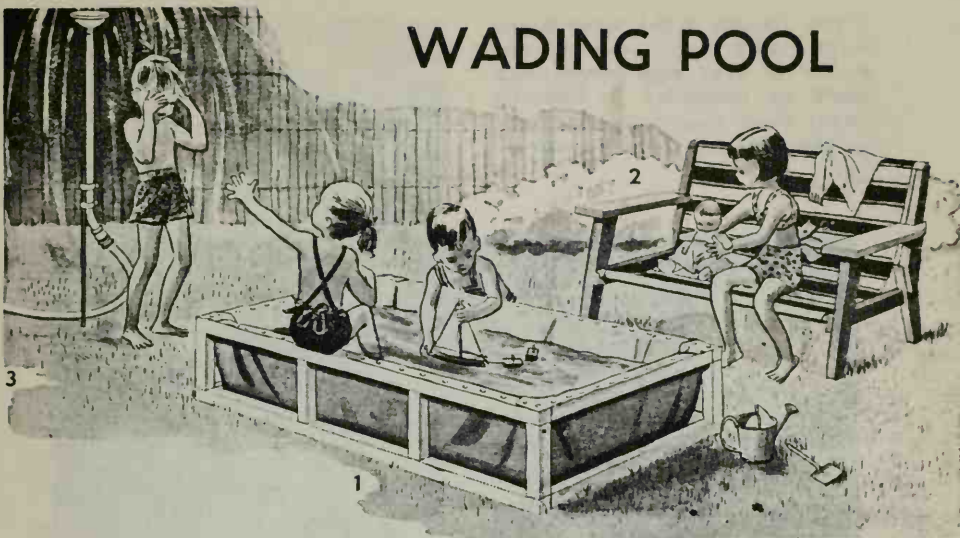
When you mount a bench vise, place it so that the stationary jaw extends 1 in. beyond the edges of the bench, and also mount it so that the jaws are at an angle of about 15 degrees to the bench edge. In this position, you can stand work on end on the floor and still grip it in the vise. Also, long work can be gripped in a horizontal position with one end resting on the bench. This keeps the long overhanging end of the work from dropping to the floor every time the vise is released to readjust the work.

Chain Attachment Adapts Bench Vise for Holding Pipe and Rod Stock



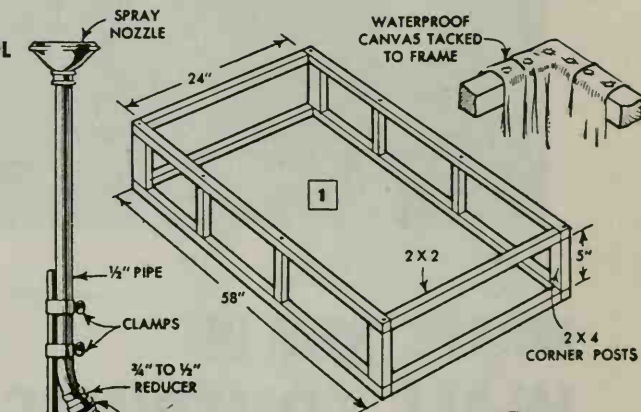
There's double duty to be had from a machinist's vise when it is equipped with this auxiliary attachment, as it then can be used for holding pipe and rod stock. The attachment is operated by movement of the vise jaws, and it pivots on a steel pin pressed in the side of the movable jaw. Two flat-iron pieces are spaced apart by two shouldered rivets and a length of bicycle chain is passed between the two rivets and held with an L-pin which provides the necessary adjustment. The opposite end of the chain is riveted to a flat-iron link which fits over a pin in the rear jaw. Note that at the rear the flat-iron members bear against the underside of the pin. In use, the chain is wrapped snugly around the pipe and is held with the L-shaped pin. A slight pressure on the vise handle causes the chain to grip the pipe tightly and prevent it from turning.

WADING POOL



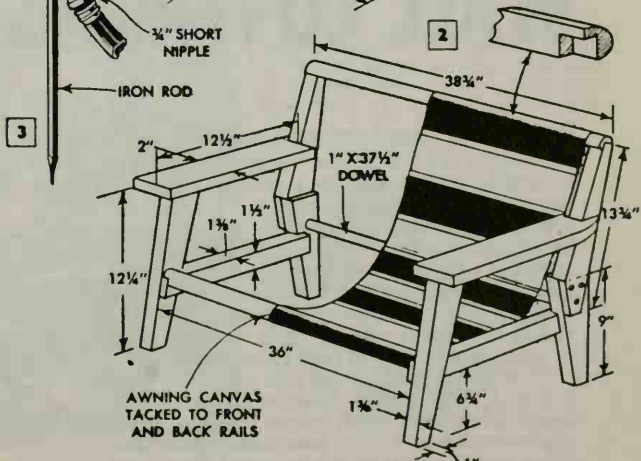
1. CANVAS WADING POOL

Made as detailed, the wading pool is large enough for sailing toy boats and splashing, but not too cumbersome to permit storage in the basement or garage. Waterproof canvas simply is brought around edges of a wooden frame and tacked securely. Water can be siphoned out with aid of a garden hose



2. SMALL-FRY BENCH

This little bench provides an ideal spot for the tots to dry out after a romp under the shower or a dip in the pool. A yard of awning canvas, 36 in. wide, is tacked to the front and back rails of the bench to form a comfortable seat. Stack sizes given in the detail may be varied to utilize lumber already on hand



3. PORTABLE SHOWER

Connected to the garden hose, the portable shower can be set up anywhere in the yard. Radiator-hose clamps hold the pipe extension to a pointed length of rod which is pressed into the ground. If spray nozzle won't fit 1/2-in. pipe, use reducer and nipple at the top of the pipe in same way as for hose connection

If you are one of the many homeowners who turns week-end carpenter to beat high labor costs, you'll be interested in knowing about these new "do-it-yourself" building products now available



U. S. Gypsum Co. photo

WHAT'S NEW IN WALL COVERINGS

SUCH OLD RELIABLES as common wall-board, plywood and plasterboard are gradually giving way to a host of new and beautiful wall coverings that are making the job of repairing, remodeling and dry-wall construction a homeowner's delight. Anyone thinking of converting attic space into living quarters, transforming the basement into a rumpus room or wondering how to hide the cracks in a plastered wall or ceiling will want to know what's new in wall coverings.

What are some of these new products? One is Panel Sheetrock, a fireproof gypsum wall-board 16 in. wide, that comes in panel form, predecorated in knotty pine and striated finishes to save you both the time and expense of





Placing ribbed texture of "bamboo" tile at right angles to each other produces pleasing basket-weave effect. Irregularities in tile joints are concealed with special colored filler

Courtesy Bolta Products Sales, Inc.

Above, bonded to the surface with a special adhesive which is applied with a trowel, this newest product in tile is actually fun to apply. Necessary tools, including joint roller, are available in kit form

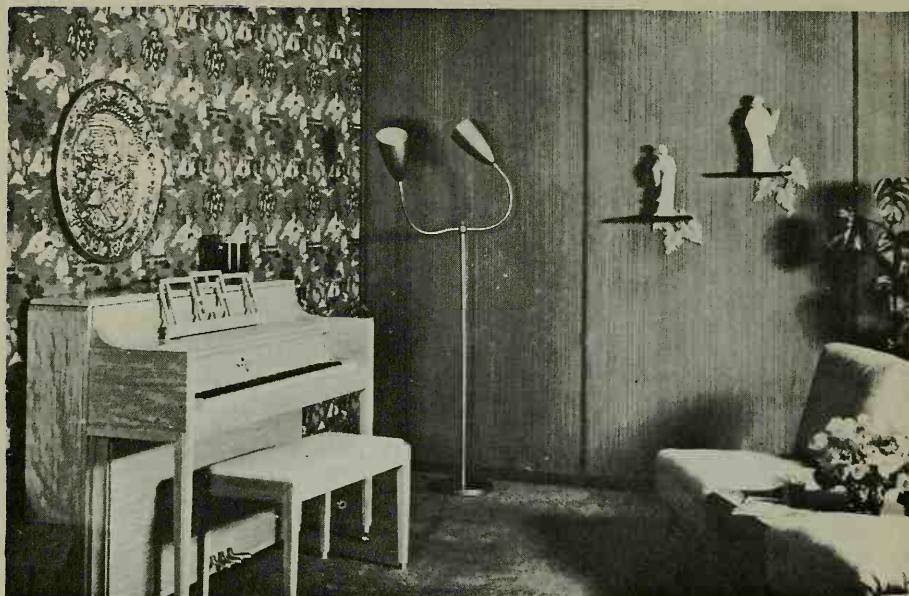
Below, swirling grain of this "sculptured" plywood paneling provides dramatic driftwood effect in keeping with texture decorating. Two-tone color treatment is optional

Georgia-Pacific Plywood Co. photo



Dramatic two-tone harmony of color and texture, as shown at left, is obtained by painting plywood with a base color, then wiping off second contrasting color





The Unison Co. photo

Contrasting wall of sturdy striated wall-board, finished green, gives "luxury look" at low cost. Lends contemporary feeling

decorating. The striking effect, as pictured (previous pg.) closely simulates real wood-grain paneling at a fraction of the cost. It's manufactured from standard $\frac{3}{8}$ -in. gypsum board in 8, 9 and 10-ft. lengths and is faced on one side with a wood-grain paper, lacquer-coated for easy cleaning. Differing from regular gypsum board where joints require taping, seam work is eliminated with this new covering, as the rounded edges of the material are a part of the over-all panel effect. In remodeling, the panels can be installed over existing walls of plaster, or wallboard. For new work, a base layer of $\frac{3}{8}$ -in. gypsum is required. Each panel is individually cemented in place with regular tape-seam cement and the way it is done is told in pictures.

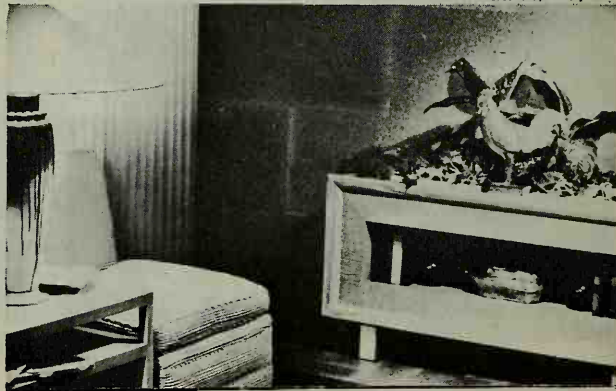
Where a small-panel effect is not desired, the homeowner now can buy regular 4 x 8-ft. sheets of gypsum wallboard pre-decorated in simulated wood grains which include knotty pine, bleached mahogany and straight-grain fir. The knotty-pine sheets have

Rich, subtle tones of cork wall tile add a distinguished air to any room as shown at right

square edges which, when butted together, form fine-line joints that look like a part of the wood pattern. The walnut and mahogany panels are made with beveled edges to form V-joints. Nailhead treatment is taken care of with special enameled nails which match the particular wood-grain finish.

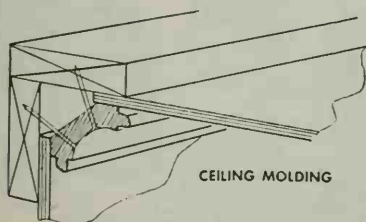
Perhaps newest in the tile field is an 8-in.-sq. vinyl-plastic tile, called Bolta Wall-Tile, which has the realistic look of genuine split bamboo. Claimed not to chip, crack, peel or become brittle with age due to its rubber-saturated paper backing, this semi-flexible material can be bent around corners, resists abrasion and staining, and can be wiped clean with a soapy cloth. It comes in several colors including natural and may be applied to a plaster, plasterboard, hard-board or plywood wall. The tiles are applied

Kentile, Inc. photo





The Upson Co. photo



CEILING MOLDING

Marsh Wall Products, Inc. photo



individually with a special water-soluble adhesive similar to linoleum cement, which is troweled on the surface. The ribbed surface of each tile is placed at right angles to the adjacent one to give a strikingly modern basket-weave effect. A special colored filler is provided to fill any irregularities in tile joints. The same material also is made in roll form 48 in. wide and in a rich, simulated leather-grain texture which offers the same ease-of-cleaning advantage. However, being produced only in large sheets, it is more difficult to handle than the tile squares and, therefore, is not recommended for application by the average homeowner.

A new texture-plywood paneling is WedgeWood, a 4 x 8-ft. lightweight board with a sculptured, swirling grain that lends itself to smart decorative two-tone color effects. The sheets can be nailed right over dilapidated plaster to modernize old rooms, or nailed to studs or furring to form finish walls in new construction. The material may be left in its natural-wood finish, or it may be painted or stained in one or two colors of light and dark shades. The panels are factory-treated with a slightly pigmented resin sealer so no priming coat is necessary before painting or staining.

New among the wallboard group are strong, laminated fiber panels by Upson. Made in sizes large enough to cover a single wall in one piece if desired (8 x 16 ft.), this economical covering comes in standard 4-ft. widths. You have a choice between an attractive pebbled surface or a smart

striated (textured) surface. The panels are pre-sized to provide a perfect painting surface. Whereas the other coverings so far described are primarily designed for wall application, laminated fiber panels are ideal for covering cracked plaster ceilings. The series of photos on page 186 show how this is done.

Long used primarily as a floor covering, the rich, subtle texture of cork tile makes an unusual wall covering for one-wall application. Kencork, one of several brands of cork tile on the market, comes in random natural tones, ranging from light oak to dark walnut, and in four standard sizes: 6 x 6, 6 x 12, 12 x 12 and 12 x 36 in. It may be obtained either factory-waxed or in a natural finish, with beveled or square edges.

Lustrous, plastic-finished panels, called Marlite, offer the homeowner a beautiful wall covering that comes prefinished in some 67 striking color and pattern combinations. Featuring a permanent baked-on finish that wipes clean like glass and never needs refinishing, the paneling faithfully reproduces the rich coloring and grain of actual, fully finished wood-grain and marble patterns. The "decal" veneers are bonded and sealed for life to panels of smooth hard-board. The panels are available in 4 x 6 and 4 x 8-ft. sizes. They are cemented in place and neatly trimmed with special metal molding.

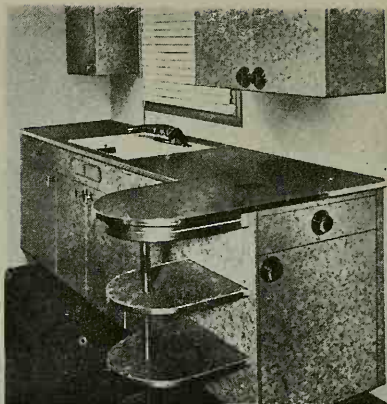
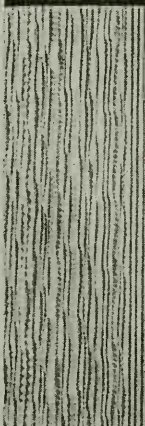
A new and completely different wood paneling has made its debut under the trade name of Novoply. A predecorated board in its natural state, it forms a distinctive wall covering as well as a warp-free material for furniture, cabinets, sliding



Novoply

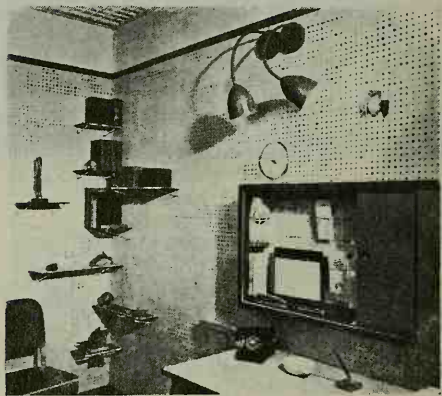


*Peg-Board
Plyweave*



United States Plywood Co. photo

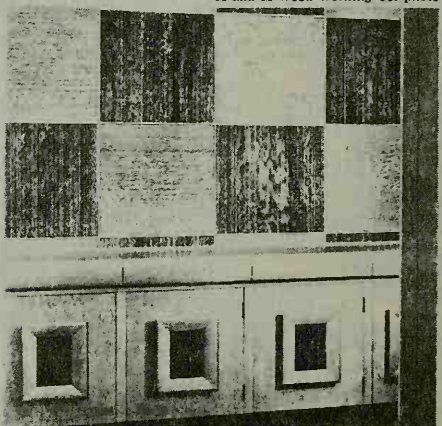
A predecorated board in its natural state, this warp-free plywood is ideal also for cabinets, furniture



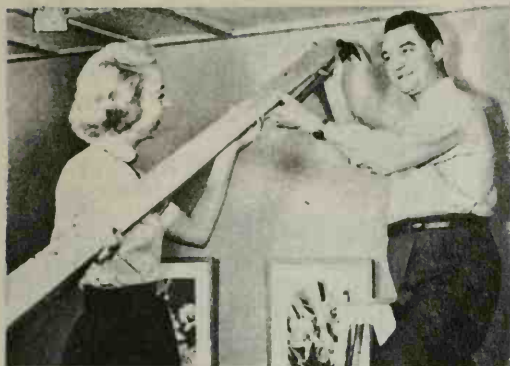
B. B. Butler Mfg. Co., Inc. photo

Above, perforated board presents brand-new concept in wall paneling, provides smart modern pattern and is highly functional. Below, checkerboard pattern of texture plywood adds interesting, one-wall contrast

M and M Wood Working Co. photo



Covering Cracked Ceiling With Laminated Wallboard

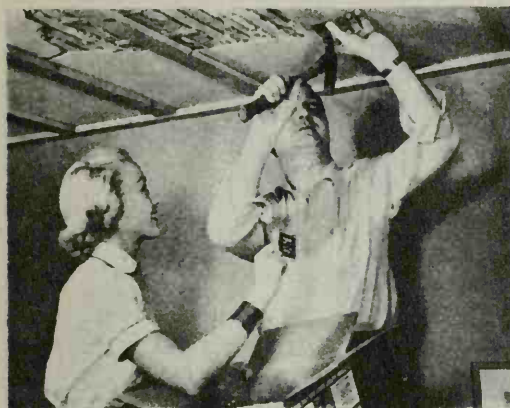


The Upson Co. photos

First step in re-covering a cracked plaster ceiling is to nail 1 x 3 furring strips, 16 in. apart, to old ceiling



Padded block is used to force prongs of fastener securely into rear side of the wallboard



Next, special metal clips, called floating fasteners, and which anchor the wallboard securely from the back, are nailed to the furring strips. Below, T-shaped prop of 2 x 4s is used to hold wallboard sheets in position against furring strips



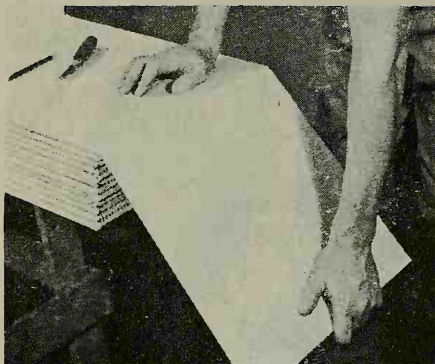
doors and built-ins of all kinds. Made of resin-coated wood flakes and chips bonded under pressure, this new version of plywood takes on an attractive variegated texture that requires no painting or staining. It comes in two thicknesses, $\frac{3}{8}$ and $\frac{3}{4}$ in., and is lower in price than common plywood due to the fact that it is manufactured from waste timber normally unusable.

While Peg-Board, a comparatively new perforated hardboard, has found wide use as a display paneling, it also offers a functional, versatile, as well as decorative, wall covering for the home. Some 60 different hanging fixtures, all interchangeable without screws, match holes in the perforated board and provide countless picture

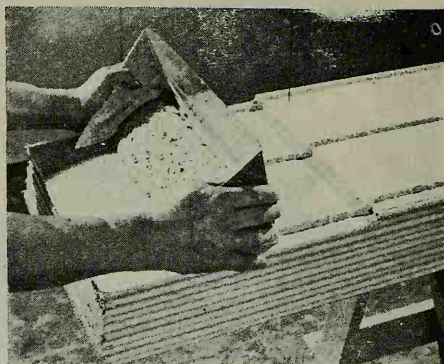
Finally, specially designed wooden moldings are applied over joints and at ceiling line



How To Apply Gypsum 16-in. Panel Board



Panels are cut by cutting through paper covering on both faces, then snapping off to break gypsum core



U. S. Gypsum Co. photos

Surplus cement, which is applied with notched spreader, is transferred to next panel in manner shown above

and shelf-arrangement possibilities without damage to the wall. In addition to a smooth surface, the perforated board can be had in an attractive simulated-leather texture.

Popular among the textured boards recently introduced is Plyweave, a fir paneling which makes a most attractive wall covering. Because it is made under heat and pressure, it presents a hard surface not easily scarred and is simple to clean. Finished with a base coat of white paint, topped with a gray glaze, which is wiped off with a cloth, a pleasing three-dimensional effect is obtained.

Several of the coverings described are one-wall coverings. Many times the overall effect is monotonous when the same covering is used on all four walls. By combining the texture of two different boards, a pleasing contrast results. ★ ★ ★

Single nail driven through panel at ceiling keeps top edge tight against wall. Molding covers nail



Above, place the first panel at a corner and plumb it with a carpenter's level. Press board lightly against surface to assure even adhesion. Below, succeeding panels are kept snug by tapping with 2 x 4

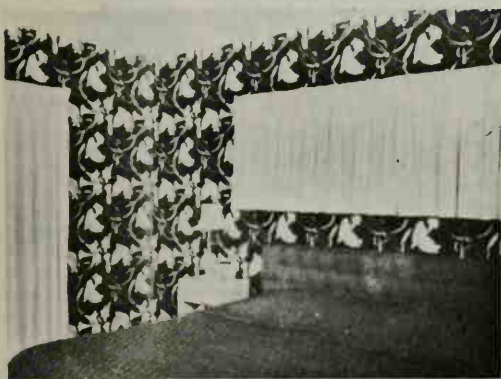


THE HANG OF WALLPAPERING

Hanging wallpaper is easy when you know how, and new papers and pastes have made it easier

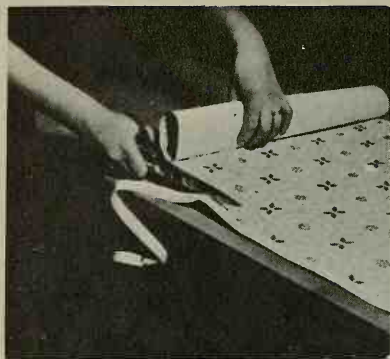
IF YOU want to give your living room a brand new mood, or provide a real lift to a tired dining room or bedroom, there's wonderful help waiting for you in the nearest wallpaper pattern book. You'll be pleasantly surprised at the grand selection being shown in wallpaper stores these days—in almost any color or pattern you can imagine, from the very traditional to the ultramodern, for every room in the house. And, what is more important, the art of wallpapering has been brought into the "do-it-yourself" field with the introduction of new papers and pastes, and new methods. Much of the muss and fuss of papering has been eliminated so that a good job can be done by almost anyone.

Selecting the paper: The heavier rough papers are an especially

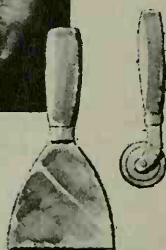
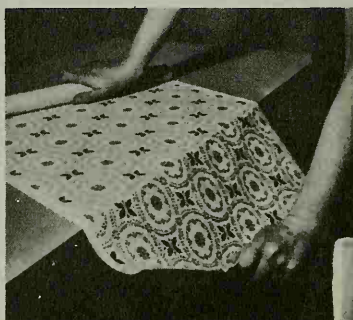
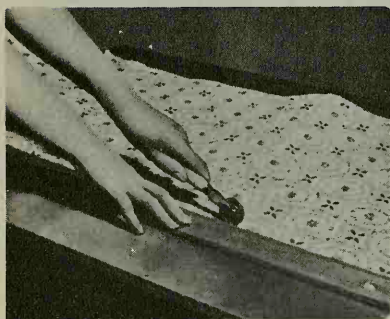


One innovation in the wallpaper field which simplifies paper hanging for the homeowner is a new paste-impregnated paper that is electronically pretrimmed. The only tools required to hang this paper are a sponge, scissors, yardstick and plumb bob





Pictures at left show two methods of trimming wallpaper prior to applying paste. Careful cutting with scissors is satisfactory, though the use of a straightedge and roller will give a better edge. If using cutting table, apply paste before trimming

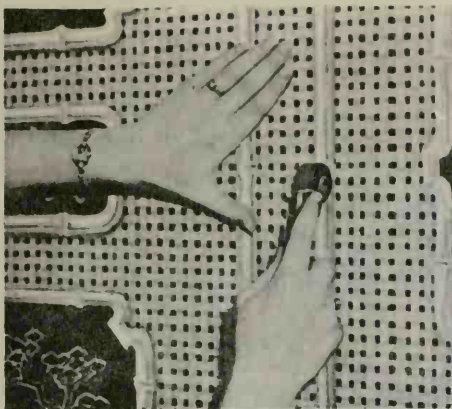


Above, curl is taken out of paper by drawing it, print side up, over the edge of a table. At left, paste is applied to top half and paper is folded to center. Then the bottom half is pasted and folded. Folding keeps the paste moist



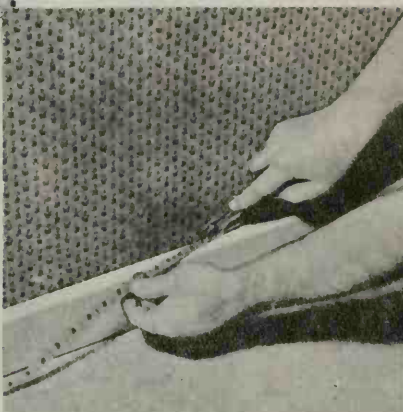
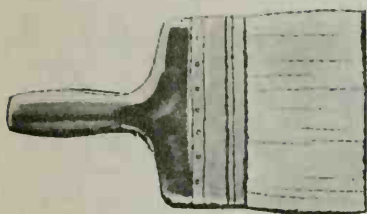
good bet for the amateur. They are easier to join, tear the least when handled and cover rough plaster, plywood and old wallpaper without blemishes. The standard wallpapers vary considerably in price. When choosing one, select only high-grade paper. Economy at this point may prove expensive in the long run. Also available are washable types of standard paper, which are easy to keep clean and new looking. Fabric wallpapers, consisting of a decorative cloth or grass mat glued to a paper backing, are popular today but are quite expensive. You can economize here by using imitation "grass cloths," which are heavy standard papers that are difficult to tell from the fabric type. Cellulose-plastic papers are among the newest additions to wall-papering. Though they have the appearance of standard papers, they can be scrubbed the same as an enameled wall. Standard wallpaper, too, can be made fully washable by an application of one of the new plastic "lacquers," which are brushed on the paper after it is hung.

Ready-pasted and trimmed papers: Designed especially for the homeowner to apply himself, papers with the adhesive already on the back and pre-



Seams are rolled after the paste has set. Usually by the time 4 or 5 lengths have been hung the paste will have set properly for rolling. Keep the seam roller wiped clean to prevent paste stains on paper

Roller cutter is used to trim paper along moldings and baseboard after paper is smoothed on with brush. Edges around door and window frames also are trimmed with roller cutter. Waste should be kept away from paper on the wall



trimmed by electronically-guided machine cutters have made their appearance. The newest of these papers is "Quick," manufactured by the Birge Co. of Buffalo, N. Y. The paper is washable, has the adhesive impregnated right in it and comes rolled with the pattern on the outside. To apply this paper, the wall is prepared by dusting and removing any loose ends of the old paper. Then, for a smoother job, the old seams are sanded flush. If the paper is to be put on a new wall, or a wall which is painted with a high-gloss enamel, a glue sizing should be put on the wall first. Even on walls which are covered with flat and rubber-base paints, it is always best to size before applying paper. In addition to the paper, which comes in standard-sized rolls, you need only a pair of scissors, a cellulose sponge and a yardstick. With every room-lot of the paper, a cardboard trough is provided to hold the water used in wetting the adhesive.

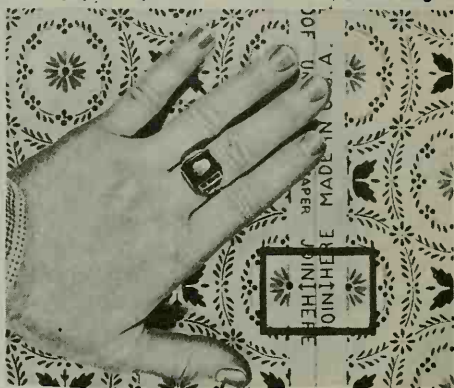
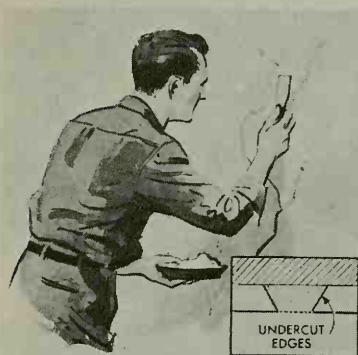
The trough, half-filled with water, is placed on the floor along the baseboard. The first strip of dry paper is cut to length, then allowed to roll naturally. Immerse the roll in the water for 30 sec., then grasp the top end of the strip and pull it out so that the roll remains submerged to permit all of the adhesive to be wet. If necessary for convenient handling, fold the adhesive-coated back against itself, just as in conventional paper hanging. Apply the adhesive side to the wall in much the same way as you would stick a postage stamp to an envelope. Since the adhesive remains wet

and workable for better than 15 min., there is no need to hurry. Slide the strip into proper position in respect to a plumbed guide line. Use the sponge with only normal pressure to smooth the material and force out the air bubbles. Only the large bubbles need concern you. The small ones which the sponge won't move will disappear as the paper dries. The paper is pre-trimmed, so neat butt seams are easy to make. Where complicated seams must be made, simply overlap the two thicknesses, cut them as required, remove the scrap and press the remaining material into place. The adhesive is nonstaining and can be wiped off the surface of the paper with a sponge or cloth at any time. If the entire room cannot be finished at one time, the job can be done piecemeal.

Tools: For standard wallpaper application, complete kits can be rented in many parts of the country at nominal cost from wallpaper dealers. Such a full set of tools includes a seam roller, shears, yardstick, paste brush, smoother brush, trimming knife, scraper, 7-ft. straightedge and a cutting table. For a small papering job, you can probably find enough tools around the house to do an adequate job. For the seam roller, substitute a clean wooden-wheeled furniture caster. Any household scissors



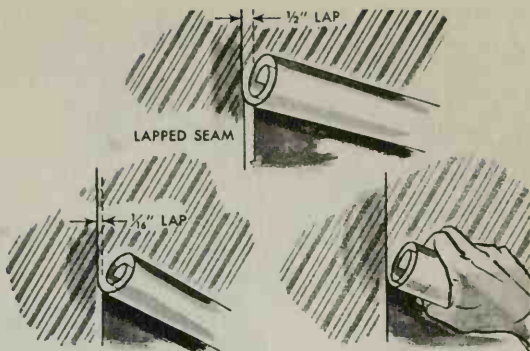
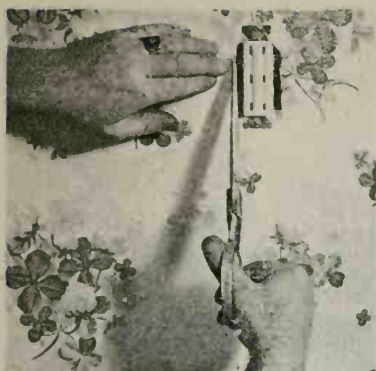
Left, new type of paste now on market is applied to wall instead of paper. Paper is unrolled on wall, eliminating cutting



Garden sprayer can be used to apply water or wallpaper-removing solution when taking off old paper. Secret of easy removal is thorough soaking of wall before scraping

will do for the shears, and the paste brush can be any large brush on hand. For the smoother, use a soft sponge. A good sharp knife or razor blade will serve as a cutter, and a trued-up 7-ft. board can be used as the straightedge. You will also need a plumb bob to start the job and some type of worktable on which to do the cutting.

Wall preparation: Getting ready is half the battle. If the old wallpaper is well bonded to the wall, there is no need to remove it. Simply smooth any lapped joints with sandpaper and start the new paper so that the new joints will not fall directly over the old. Do not size the old paper. If there is any indication of a poor wall bond, completely remove the old paper. The common way to do this is to soak the paper, using a large brush or a paint roller dipped in hot water. The spray attachment on your vacuum cleaner can be used to wet the old paper. Go entirely around the room, wetting the paper thoroughly. When the last wall is soaked, the first paper should be loose enough to remove with the scraper. Adding a little baking soda, borax or ammonia to the water will aid in softening the paste. Or better yet, use one of the new wallpaper-removing solutions now available at your paint dealer. In some localities, equipment for steaming off the paper can be rented. When all of the paper has been removed, wash down the walls with a sponge and let dry. Holes and cracks in the plaster



WIRE-EDGE SEAM

PLAIN BUTT SEAM

Paper is pasted directly over switches and wall outlets after cover plates are removed. When paper is completely dry, it is trimmed away with scissors

The lapped seam is the easiest to make since only one edge need be trimmed. Wire-edge seam looks better but is harder to match. Butt seam is smoothest

are filled smoothly with patching plaster. Very porous plaster, new plaster, plaster-board and plywood walls should be glue-sized. The size is mixed with hot water and applied while still warm, using a large brush to apply it quickly before it jells. Let the size dry thoroughly before papering, or it may stain through. Walls which have been painted should be washed before sizing, and calcimine or whitewash should be thoroughly removed with hot water. On rough walls, such as sand-plaster finishes, apply a lining paper or lining felt first. The liner also should be used on plywood to hide the grain if a thin paper is to be used. Wallpaper may serve as a liner if the pattern side is placed against the wall.

Estimating rolls: Because some rolls of paper vary in size, it is best to have your wallpaper dealer figure the number of rolls needed. Give him the length, width and height of the room, plus the number of doors and windows. Or you can estimate the number of single rolls (the standard 8-yd. roll) by using the table on this page. Subtract one roll of paper for each two doors and window openings.

Paste: Regular wallpaper paste can be purchased ready-mixed, requiring only the addition of water according to the directions. Use a small paddle to mix the paste. For lightweight papers, make the paste thin, while for heavy papers, keep it quite stiff. The new plasticized pastes, which come ready to use, are a boon to the beginner because they smooth out well and will not stain the paper. The latest innovation in pastes is one which is applied to the wall instead of to the paper. Made by Easy Hang Adhesives, Inc., of Aurora, Ill., this new paste eliminates precutting of the paper. After the paste is applied to the wall, the end of the paper is pressed in place at the top of the wall, allowed to unroll to the bottom, and cut off at the baseboard after brushing down. The next strip is matched

to the first and put on in the same manner.

Cutting to length: Before cutting the paper, see that all rolls are from the same factory "run" number, for the best match. Examine the pattern closely so you can cut it without waste. Usually there will be "join" marks on the edges of untrimmed papers. There are two types of wallpaper patterns, the straight and the drop. With the straight pattern, all lengths of paper are cut on the marks to match. With drop patterns, the strips will match only if you drop each successive strip half the pattern design. Thus, if the pattern repeats itself every 18 in., the next length of paper must be lowered 9 in. to match. In using a drop pattern, cut from two rolls for economy, one on the marks and one halfway between the marks. Before cutting regular paper, take the curl out of it by sliding it, print side up, over the edge of a table.

Pasting and trimming: If you trim the edges with scissors, do it before pasting, using a yardstick to draw a light trim line. If trimming with a knife and straightedge or on a cutting table, trim after pasting, so as not to get paste over the finish edges. The trimming also depends on the type of joint you use—lap, wire or butt. The lapped joint is the simplest and requires trimming

ROLLS OF PAPER FOR ROOMS

Lineal ft. of walls	Height of room				Rolls for ceiling
	8'	9'	10'	11'	
48.....	12	13	15	16.....	2
52.....	13	15	16	18.....	3
56.....	14	16	17	19.....	3
60.....	15	17	19	20.....	3
64.....	16	18	20	22.....	3
68.....	17	19	21	23.....	3
72.....	18	20	22	24.....	4
76.....	19	21	23	26.....	4
80.....	20	22	25	27.....	4
84.....	21	23	26	28.....	4
88.....	22	24	27	30.....	4
92.....	23	26	28	31.....	8
96.....	24	27	30	32.....	10
100.....	25	28	31	34.....	13
104.....	26	29	32	35.....	14

Single rolls



When papering ceiling, the paper is carried loosely folded back and forth across a stick or odd roll of paper. It unfolds easily as you cross the room

only one edge. For the wire joint, both edges are trimmed, but do not need to be perfectly true because they lap about $\frac{1}{16}$ in., leaving less bulge than the lapped joint. The butt joint is the very best but requires perfectly true edges to butt together snugly. The ready-trimmed paper makes excellent butt joints.

To apply paste, lay a cut length of paper upside down on the table and spread the paste evenly on the upper half. Then, without creasing, fold the end of the pasted half to the center. Paste the other half and repeat the fold to the center. This keeps the paste clean and prevents drying out. If the edges are to be trimmed, keep the selvage perfectly even when folding. Lay the straightedge on the folded paper and trim. Work fast with thin papers or the paper will become too wet and may tear. Avoid pasting or hanging in a drafty room because fast drying may crack the paper. Don't let paste dry on the table—wipe it off after each day's use.

Hanging the paper: The trick of papering is to hang the first length plumb. Start on the obscure side of a door or window, because the last length is difficult to match exactly against the first. If the door or window is not plumb, run a plumb line from the top of the wall one length of paper away from the frame. Hang the first length to this line, trimming to fit the frame. When hanging paper, carry the pasted lengths folded to the wall. Unfold the top half by lifting the top high and letting it unfold slowly of its own weight. Press the top corners in place with your fingers, leaving an inch or so of paper above any top mold-

ing. Smooth out the paper with the brush, crowding the upper end tight against the molding. Unfold the bottom half and repeat the smoothing. If a wrinkle appears, pull the paper gently away from the wall and smooth back in place again. Use a roller cutter to trim at the baseboard and ceiling molding. Before the paste dries, wipe off any excess on the woodwork. Cut the paper $\frac{1}{2}$ in. wider than needed around doors and windows and crowd into place against the wood, then trim with the roller cutter. For corners, measure from the last length hung to the corner, and cut a strip $\frac{1}{2}$ in. wider than this measurement. Hang this strip, crowding the extra $\frac{1}{2}$ in. around the corner with the smoother. Then hang the remaining part of the cut length as the first length on the adjoining wall, using a butt joint, thus matching the pattern. Use a chalked plumb line again to hang this first strip on the next wall. Always have clean damp cloths available to remove any paste marks on the paper. Roll down the seams of the paper after 4 or 5 strips have been hung. Keep the seam roller wiped clean. At electric outlets and switches, remove the cover plates and paper over the openings. Then trim with a scissors when fully dry. The border at the ceiling is hung last, starting in an obscure corner.

Ceilings: Ceilings today are often painted, but can be attractively papered with less difficulty than you might imagine. As with the wall, the secret of overhead paper hanging is in starting out correctly. A ceiling is always hung before the walls, and is started by snapping a chalk line about 16 in. out from the wall and hanging to this line, carrying the paper down the wall about $\frac{1}{2}$ in. Using butt joints, the paper can go either across the room (shorter and simpler) or lengthwise (fewer seams). But with lap or wire joints, it is important to start along the lighted side of the room so that shadows will not be cast from the seams, making them noticeable. Carry the paper to the ceiling folded loosely back and forth over a stick or odd roll of wallpaper. Press the end in place. Then, as you continue across the room, the paper will unfold as you smooth it in place. Ceiling seams are rolled down firmly, as on the walls.



FIG. 1

Photo courtesy U. S. Plywood Corp.

Miracles of transforming tired old walls to new ones within a few hours are now possible by using modern dry-wall coverings available in the convenient form of planking, which home owners can apply easily and quickly

WALLS

TODAY'S GREAT VARIETY of attractive dry-wall materials meet all requirements of modern room planning. Some materials give added insulation, others provide exceptional strength. A great number are prefinished to eliminate the need of subsequent painting. You can have your choice of soft and hard wallboards or plywood, Fig. 1. There are various kinds of "tile," including those of stainless steel, Fig. 2. You can also use glass blocks, structural glass or decorative glass sheets, Fig. 3.

Advantages of dry-wall construction: Many dry-wall covering materials offer considerable economy. The simplicity of application makes it possible for home owners to install them without any difficulty. Cutting wallboards usually can be done with a handsaw although some materials can be scored with a knife and then fractured neatly. Unlike plaster, dry-wall materials do not introduce moisture into a house and therefore do not require a period of drying out.

Interior walls are covered only after the

concealed wiring, plumbing and heating extensions have been completed. Insulation and vapor barrier as may be necessary in outside walls must be installed before applying interior wall coverings.

Types of wallboard: Common types of wallboard include pulp boards of relatively soft and intermediate consistency, various types of hardboards and gypsum board. For fast application you can use the large sheets commonly known as "building board." These come in standard 4-ft. widths, and in lengths often up to 12 ft. The edges may be square or beveled to form a V-groove between adjoining panels. Smaller panels in 32-in. widths and in 8 and 10-ft. lengths, and having tongue-and-groove or lapped edges, also are provided.

A popular form of board is called "planking." This comes in widths of 8 to 16 in., making it easier to handle than the larger 4-ft. panels. Edges are tongue-and-groove or lapped, which conceals nails or clips used for fastening. Planking, like building board, can be installed either vertically or

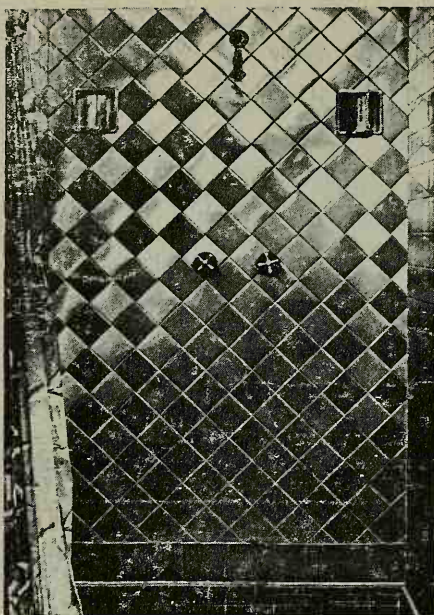


FIG. 2

Photo courtesy Vikon Tile Corp.



FIG. 3

Photo courtesy Libbey-Owens-Ford Glass Co.

horizontally. Small square or rectangular panels of the same material, called "tiles," often are used on ceilings, but can be applied to walls as well. Sizes are 12 or 16 in. square, 12 by 24 in., and 16 by 32 in. They have tongue-and-groove edges all around, and can be arranged in various ways as shown in Fig. 4.

Insulating wallboard: The softer kinds of wallboards have definite insulation value largely because of tiny, isolated air spaces they contain. The degree of insulation value is influenced by the material from which they are made as well as the processing method used, which gives them varying degrees of density. Many insulating wallboards are available in several soft colors and pleasing textures. Their thickness varies from $\frac{1}{4}$ to 1 in. generally. When used in positions vulnerable to impact, the thin boards should be applied directly on a solid, rigid backing such as plaster, wood or plywood for additional strength. The thicker varieties do not require such backing. Some insulating boards are faced with foil or are coated on one side to form a vapor-barrier covering.

Hardboard: Hardboard is dense and tough, and has many characteristics of wood. It is highly resistant to scuffing and to moisture absorption. Various kinds are shown in Fig. 5. They range in thicknesses from $\frac{1}{8}$ to $\frac{3}{16}$ in. The face surface generally is smooth, and the back has a canvas-like texture. The "tempered" kind has much

greater density, and about seven times the strength and abrasion resistance as the regular type. Some kinds are prefinished on one side with baked enamel simulating tile. Another prefinished hardboard resembles leather.

Asbestos-cement board: This is strong, hard and durable yet somewhat flexible. It is fireproof and rodentproof; resists acids, alkalis and grease; will not swell or buckle when exposed to hot water or steam, and is highly resistant to scratching and marring. The material comes in $\frac{1}{8}$, $\frac{3}{16}$ and $\frac{1}{4}$ -in. thicknesses. It is available in unpolished, light-grey color, in a highly polished light-grey surface, or in a pleasing fabric pattern in many colors. Besides these finishes, scored panels to simulate planking or tile also are furnished.

Gypsum wallboard: Gypsum wallboard consists of a gypsum core encased in thick, tough manila paper. It has exceptional resistance to fire. It is obtainable in various wood-grained finishes: also in tile-effect and striated surfaces. One kind is backed with foil, which serves as reflective insulation and also as a vapor barrier. Thicknesses vary from $\frac{1}{4}$ to $\frac{1}{2}$ in. Edges of panels may be square, beveled, or they may be recessed to take joint-covering tape and cement.

Wood and plywood: Where the natural grain of wood is desired, you can use either wood or plywood. The edges of wood planks may be square or tongue-and-

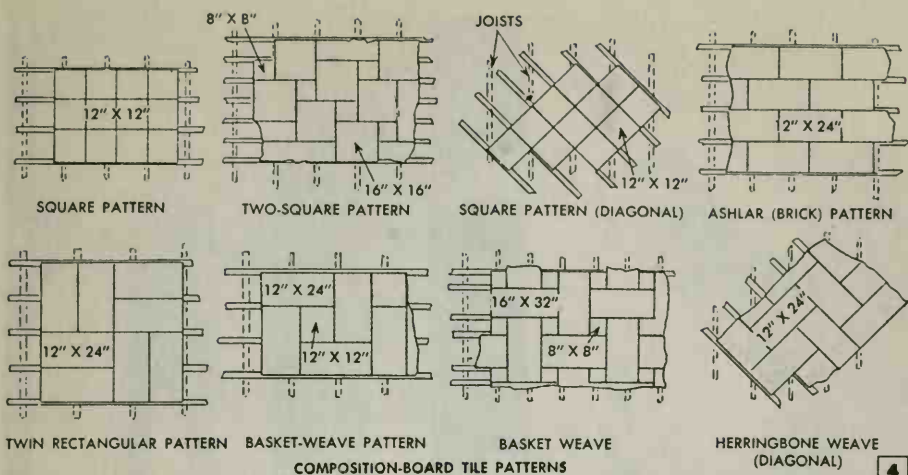


Photo courtesy Celotex Corp.

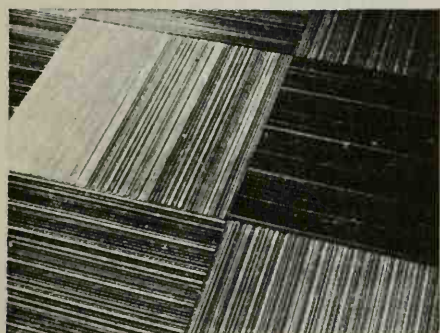


FIG. 6 Photo courtesy U. S. Plywood Corp.

groove. Plywood surfaces may be smooth, striated as in Fig. 6, or otherwise textured. The popular thicknesses are $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$ and $\frac{3}{4}$ in. The face ply may be birch, knotty pine, walnut, oak, elm, mahogany or other wood. Plywood planking that has tongue-and-groove edges also is available.

Basic layouts for 4-ft. widths: Wallboard and plywood of standard 4-ft. widths can be installed either vertically, Fig. 8, or horizontally. Fig. 9 shows three basic arrangements that have been found best for economy and appearance on walls that are cut up by doors and windows. Generally, fewer joints are required for horizontal application. Vertical joints should come in

line with vertical edges of doors and windows. When a space between corners and doors or windows is greater than 4 ft., but less than 8 ft., the second panel from the corner is cut so that one edge will come on an intervening stud, and the other in line with the door or window. When panels are arranged horizontally the upper one is installed first. Where wall space is not cut up by doors and windows, horizontal panels should span walls from corner to corner if possible. Where this cannot be done, the vertical edges of panels should be staggered so they will not fall on the same studs.

Methods of fastening: Most dry-wall coverings are fastened with nails. Planks and tiles also may be attached with clips. The softer varieties may be stapled as in Fig. 7. Adhesives can be used on some of the boards when they are placed in direct contact with flat, solid backing. In all cases manufacturers' instructions should be followed explicitly since variations in products necessitate minor differences in application.

Nailing bases: When panels of 16, 32 or 48-in. widths are installed vertically on standard wall framing, the panel edges will fall over studs for nailing. Upper and lower edges of the panels are nailed to top and sole plates of the framing. When a wall is

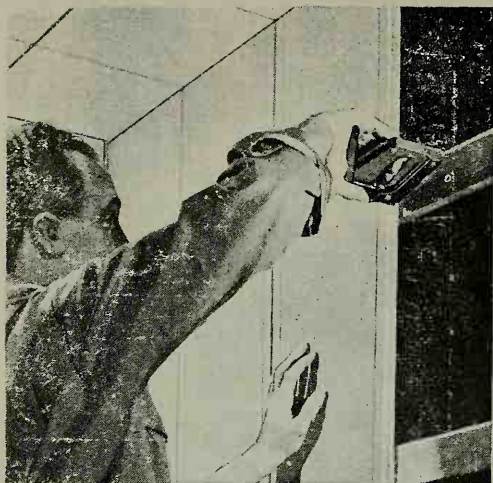
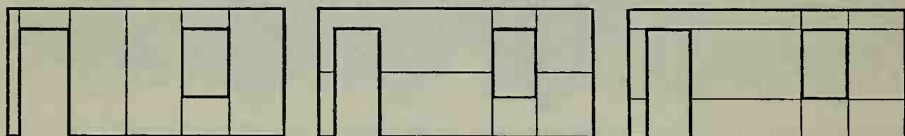


FIG. 7



FIG. 8

Photos courtesy Celotex Corp.



BASIC ARRANGEMENTS OF WALL PANELING

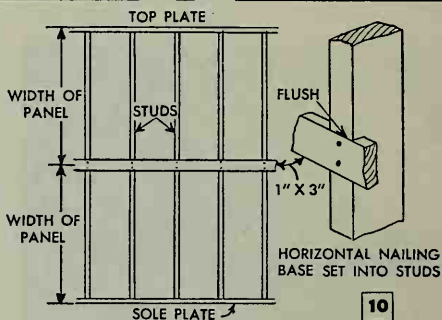
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covered with two wide panels arranged horizontally, the edges crossing studs can be provided with a nailing strip set into the studs as shown in Fig. 10. When planking less than 16 in. wide is arranged vertically, or planking of any width is applied horizontally, you need furring strips nailed horizontally over studs as in Fig. 7. Furring strips also are required for the installation of tiles. Usually furring strips are spaced about 12 in. on centers, but an 8-in. spacing often is recommended for soft boards.

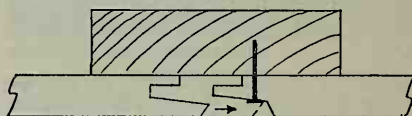
Wallboards and plywood can be applied directly over plaster that has a uniformly flat surface. Loose and crumbling plaster should be removed, and the space blocked up with wood fillers to plaster height. If a plaster surface is irregular, the wall should be furred out, the furring strips being shimmed up in some places and cut down in others to produce a true plane.

Nailing recommendations: As a rule, nails securing wallboards should penetrate into solid wood about 1 in. For example, a 1/2-in. panel fastened directly to studs requires 1 1/2-in. nails, and a 1/4-in. board over 3/4-in. plaster needs 2-in. nails to penetrate studs the required distance.

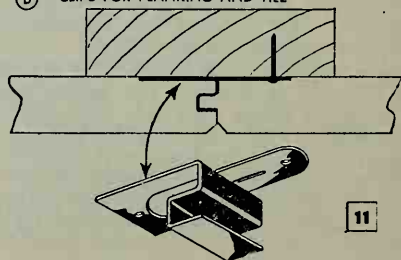
When applying building board you generally start by driving nails into intermediate studs, joists or furring strips, after which you nail the edges, using box nails



10



- (A) NAILED TO FURRING STRIP
- (B) CLIPS FOR PLANKING AND TILE

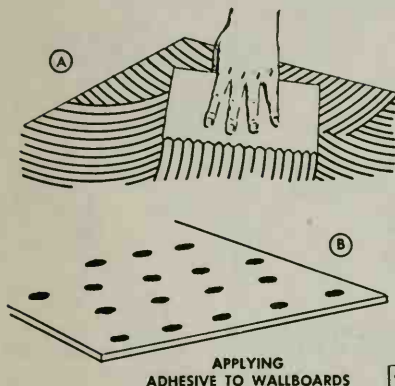


11



FIG. 12

Photo courtesy Wood Conversion Co.



of proper length. Nails are spaced 6 in. on intermediate studs, 3 in. along edges and not closer to them than $\frac{3}{8}$ in. For hard-board the nail spacing is 8 to 12 in. on intermediate studs, 4 in. at edges and not closer than $\frac{1}{4}$ in. For asbestos-cement board, the spacing is 16 in. on intermediate studs, 8 in. along edges and not closer than $\frac{3}{8}$ in. With the latter material nailing is started along one edge and then across the board to "wipe" the sheet smooth.

For nailing gypsum board, you use cement-coated cooler-type nails, the 4-d. size for $\frac{1}{4}$ and $\frac{3}{8}$ -in. thicknesses, and the 5-d. size for $\frac{1}{2}$ -in. thickness. When the board is applied to ceilings, nails are spaced 5 to 7 in., but on walls the spacing is 6 to 8 in. In both cases the nails should be spaced about 12 in. on intermediate studs, 6 in. along edges and not closer than $\frac{3}{8}$ in.

Use 6-d. nails for $\frac{1}{16}$ and $\frac{3}{8}$ -in. plywood. Often plywood is glued to the framing in addition to being nailed, which gives considerably greater strength and rigidity than nailing alone. To avoid hammer marks on

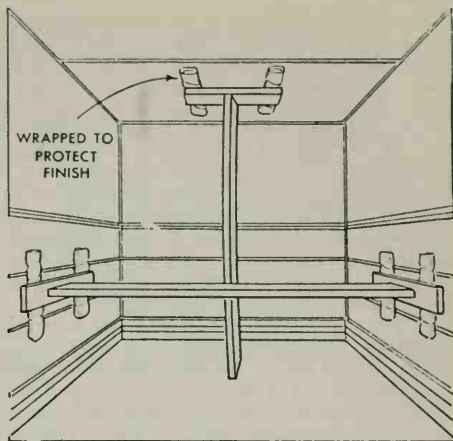


FIG. 13

wallboards you drive the nails to within a short distance from their surface, then finish with a nail set. If nails must be pulled, use a block of softwood of suitable size under the hammer head. Where casing or finishing nails are used to fasten the denser types of wallboards, the nails are sunk slightly below the surface, and the holes filled with suitable putty or crack filler. Most wallboards should not be toenailed. Nails should be of the rust-resistant variety in locations exposed to excessive humidity.

Fastening planking and tiles: Tongue-and-groove planking and tiles may be nailed as shown in Fig. 11-A, with $1\frac{1}{8}$ -in. blued lath nails spaced about 8 in. apart. Special clips often are used as in detail B. Clips give complete support yet allow a slight movement of the material as occasioned by expansion and contraction because of humidity and temperature variations. On planking of the insulation-board kind the spacing of clips should not exceed 8 in. For tiles of the same material, the spacing should be 4 to 6 in. Clips on plywood planking may be spaced about 16 in. apart. For the softer kinds of boards, stapling as in Fig. 7, affords a much faster means of attachment than nailing or using clips. For this you use an automatic, trigger-action stapler. The staples should be of the rust-resistant variety having $\frac{3}{16}$ -in. legs.

Starter strip for tiles: The application of tiles is started on a straight line near the center of an area, and you work toward the edges generally. When locating the starting line, measure to the edges of the wall and make the necessary adjustment to avoid getting narrow pieces of tiles along the edges. Starting tiles straight is facilitated by using lengths of straight wood

temporarily nailed to the surface or across furring. You can also use milled starting strips as shown in Fig. 24, which fit the grooves of the tiles, are concealed by them, and are left in place permanently.

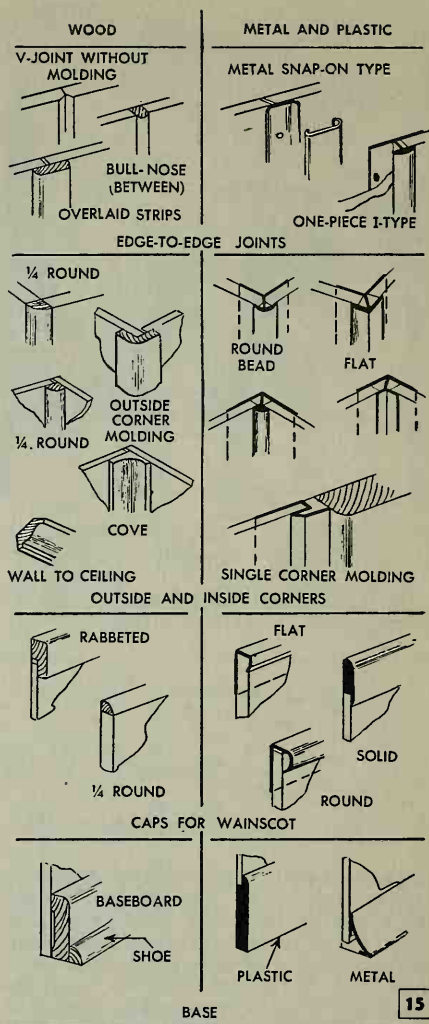
Use of adhesives: Most types of wallboards can be cemented when installed in direct contact with a flat, solid backing. Manufacturers supply special adhesives for this purpose. For many boards you can use waterproof linoleum cement. This is spread evenly over the entire back surface with a trowel or spreader having $\frac{3}{16}$ -in. notches along one edge as shown in Fig. 14-A. Another method is to apply the adhesive in staggered spots about 3 in. in diameter and 12 in. apart, as shown in detail B. After applying adhesive to a panel, you set it in position and press it down uniformly into firm contact with the backing. Large panels can be held against the walls and ceiling securely with braces as shown in Fig. 13, to assure uniform contact. The braces are left in place for at least 12 hrs. Sometimes nails are used instead of braces. The nails are sunk later and the holes concealed with putty or filler. On tiles, adhesive is put on in dabs near corners as shown in Fig. 12, or in ridges near long edges.

Joint and corner treatments: V-grooves between wallboard panels usually are left uncovered. Where wallboard is to be painted, cracks between square edges of adjoining panels often can be filled with a suitable putty or crack filler. Molding strips of wood, plastic, metal, or the same material as the board, often are used at joints and corners as shown in Fig. 15. Metal corner moldings are nailed in place first and then the board is inserted.

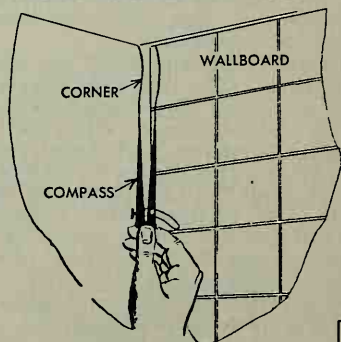
Often corners of rooms are not straight nor vertical. In such cases the irregular line of a corner is marked on the board with a compass as shown in Fig. 16 while the board is held so that its opposite edge is vertical, as may be checked with a level. This method of marking is used also where wallboards join uneven or sloping floors.

Taped gypsum-board joints: Steps in forming smooth, seamless joints on recessed-edge gypsum board are shown in Figs. 17 to 19. You also "spot" the nail holes and other indentations. Allow the cement to dry for 24 hrs., after which you apply another very thin coat to compensate for shrinkage, feathering the edges. When dry, the last coat is smoothed with sandpaper held on a block. Inside and outside corners may be treated similarly with tape and cement, or they can be finished with molding.

Hints on installing wallboards: Ceilings should be covered prior to walls. When large panels are used for this the joist locations can be marked on the side walls as a



MARKING WALLBOARD TO FIT CORNER



15

16



FIG. 17



FIG. 18



FIG. 19 Photos courtesy U. S. Gypsum Co.

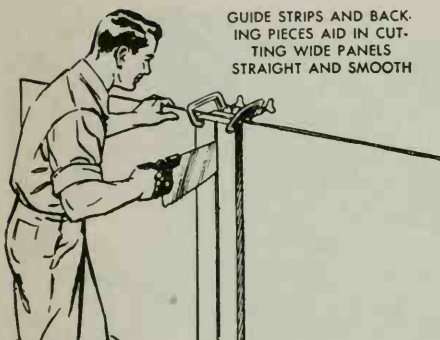


FIG. 20

GUIDE STRIPS AND BACK-
ING PIECES AID IN CUT-
TING WIDE PANELS
STRAIGHT AND SMOOTH

guide for nailing. A chalk line may also be snapped on the wallboard to facilitate nailing in straight rows. Panels can be held firmly against a ceiling by means of T-braces as shown in Section 4.

When covering a plastered wall with relatively thick wallboard, you remove the trim first. Before replacing it, the door and window frames must be extended by means of wood strips, the same thickness as the wallboard. Then, for best appearance, the hinges, lockplate and doorstops should be relocated. Thin wallboards and plywood however, can be brought up to trim without the need of removing it, except the baseboard.

Plumbing and electrical fixtures often must be disconnected and moved out of the way, as well as plates of switches and wall receptacles. The location of plumbing and electrical outlets must be marked carefully on the board, and suitable holes cut or drilled to accommodate them. The boxes of electrical outlets must come just below the surface of the wall covering.

Sawing and breaking wallboards: When sawing wide panels you can make straight cuts with very little fraying if you use guide strips as in Fig. 20. Pairs of these are clamped together at their ends with

the wallboard between them, and are spaced apart the width of the saw blade.

Although gypsum board can be cut with a handsaw, it is much easier and quicker to score it with a sharp knife, Fig. 21, break it at the score line by snapping downward, Fig. 22, and then cutting the back paper covering, Fig. 23. Rough edges are smoothed with sandpaper held on a block. Asbestos-cement board can be scored and broken in similar manner, or it can be cut with a large shears.

Working with hardboard: As hardboard expands and contracts slightly because of humidity changes, it is necessary that the moisture content at the time of installation be greater than at any time thereafter. To increase the moisture content, you stack the panels in pairs with the face sides together, placing wet cloths or newspaper between them. Lay a tarpaulin over the stock to prevent evaporation. After 12 hrs. you can start to install the panels. Don't butt the edges together tightly but leave a $\frac{1}{16}$ -in. gap. Hardboard can be bent to relatively small radii after it has been soaked in water for an hour.

Wallboards over masonry or concrete: Where it is desired to cover masonry or concrete with wallboard or plywood, first investigate the condition of the walls in regard to dampness. Damp walls should first be treated with any of several damp-proofing paints such as discussed in Section 5. Then furring strips are fastened to the walls and wallboard or plywood is attached to these. Besides minimizing the possibility of moisture absorption by the wallboard when so installed, furring strips also provide a means of air circulation. Where plywood is used for a wall covering in damp locations, it should be of the exterior type—the kind that has a waterproof bond between the plies. There are some types of wall coverings that can be applied directly on dry masonry and concrete surfaces.

Linoleum on walls: Where a resilient,

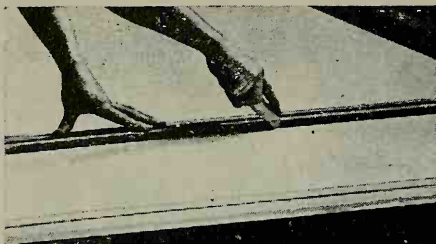


FIG. 21

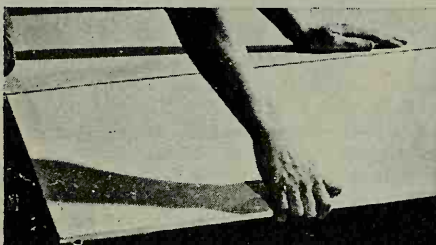


FIG. 22

Photos courtesy U. S. Gypsum Co.

durable, grease-resistant and washable wall surface that is relatively inexpensive is desired, you can use wall linoleum. This is thinner than that used for floors and counter tops. It is ideal for kitchens and bathrooms, but is not recommended for use around showers and built-in tubs, or other places exposed to excessive moisture. The material comes in many colors; in marbleized or tile patterns. It is supplied in rolls 3 to 6 ft. wide. Linoleum cap strips for wainscoting, and fillet strips for corners are furnished also, as well as border strips.

Wall preparation for linoleum: Wall linoleum can be glued directly to plaster, gypsum board and other wallboards having a smooth, dry surface. Loose or cracked plaster should be repaired and the patched surfaces sanded smooth with No. 3 sandpaper. Wallpaper and loose, scaling paint should be removed. Where paint and enameled surfaces are in good condition, they should be sanded to assure good adhesion. Plaster should be given a sizing coat where it is dusty or porous. The paper face of gypsum board also requires sizing. The work should be done at a temperature of 68 deg. F. or above, and the linoleum should be exposed to this temperature for at least 48 hrs. prior to applying it.

Installing linoleum: Since room corners are seldom plumb, vertical seams of the linoleum should not be started here but about 5 or 6 in. from corners at a vertical line. The fillet strips and corner molding are installed first. Adhesive such as that recommended by the manufacturer is spread on the wall to uniform thickness, using a toothed trowel having notches $\frac{1}{16}$ in. deep, $\frac{1}{16}$ in. wide and $\frac{1}{8}$ in. apart.

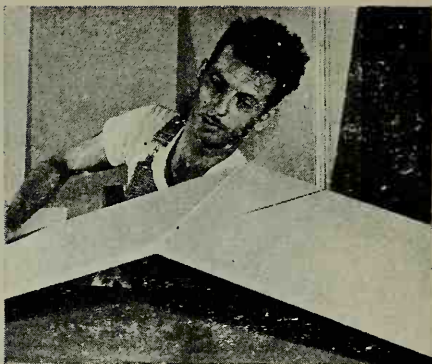


FIG. 23

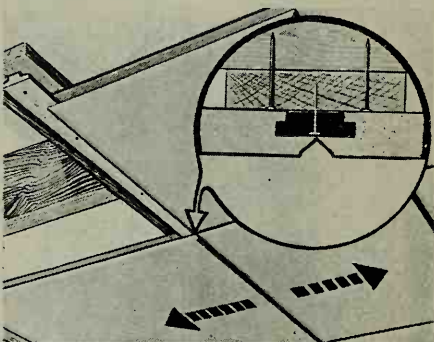


FIG. 24

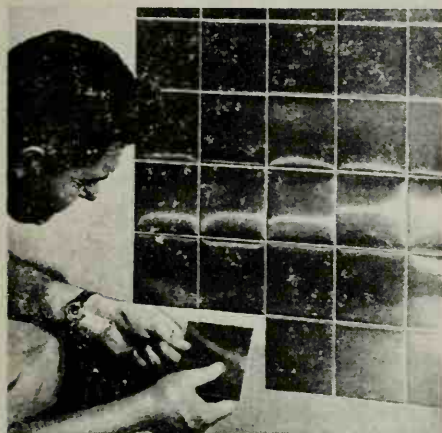
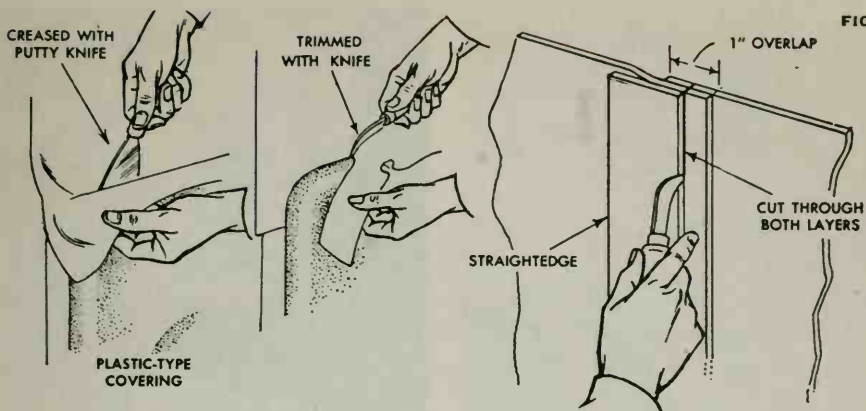
Photo courtesy National Gypsum Co.



FIG. 25

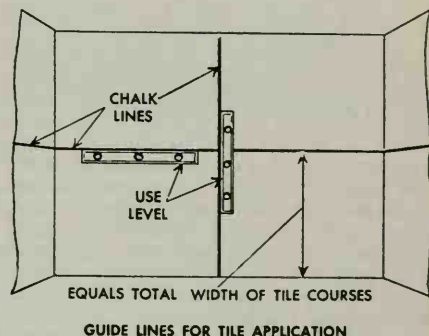
Photo courtesy Congoleum-Nairn, Inc.





Press the linoleum into firm contact with the wall, working it with the hands from the center toward the edges to exclude air bubbles as shown in Fig. 25. Wipe off excess adhesive and smudges with a damp cloth as soon as each piece is in position. On marbled patterns, the second piece is placed so that the preceding piece overlaps it about an inch. Then, using a linoleum knife, you cut through both pieces at the same time as in Fig. 26, to assure a well-fitting joint. To make straight cuts use a straightedge. On tile patterns the cut is made on the "mortar joint."

Other flexible wall coverings: There are a number of wall coverings which are flexible and come in roll form. Some are also available in squares. For satisfactory results with such coverings, they should be applied only to smooth, dry walls. Cracks and breaks in plaster should be patched and sanded, seams of wallboards and plywood filled or taped, and porous surfaces coated with sizing. Adhesives recommend-

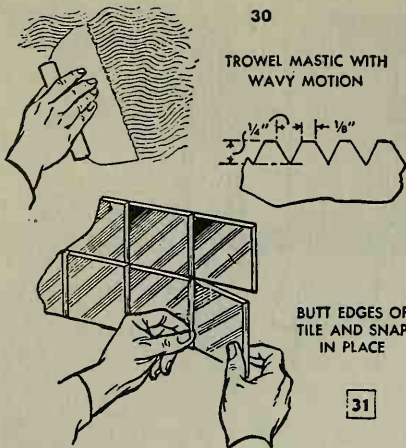


29

ed by manufacturers should be used. After an adhesive is applied to a wall, the covering is placed over it and the surface worked by hand or with a roller to eliminate air bubbles.

Enamel-surfaced coverings usually are installed horizontally from a level guide line. Joints are butted together, edges being cut prior to hanging the material. Soft, plastic covering materials are hung vertically, using a plumb line as a guide. They can be formed around corners. For inside corners, the material is creased before hanging it. The sheets are overlapped and the seams cut on the wall as shown in the right-hand detail of Fig. 27. Pressure on a straightedge prevents stretching the material. Because of the resiliency of plastic-type coverings they can be fitted around plumbing fixtures such as wall lavatories, by creasing with a putty knife as shown in the left-hand detail of Fig. 27. Then they are trimmed with a linoleum knife as in the center detail.

Various types of tiles: You can obtain individual wall tiles of plastic, stainless steel, enameled steel or aluminum, glazed clay,



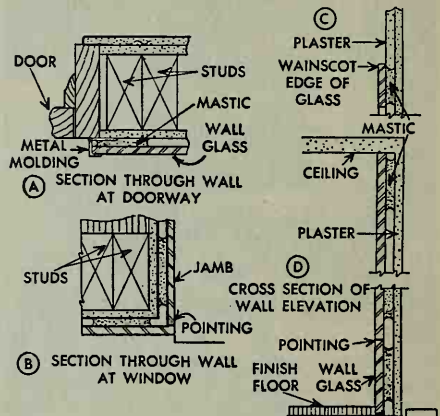
glass, asphalt, rubber, cork and other materials. They come in various sizes and are either square or rectangular, and are simply cemented in place one by one as shown in Fig. 28, using a suitable adhesive. Large expanses of wall area are covered by "field" tile, which differs from that used for caps, feature strips, bases and corners. Many tiles can be attached directly to plaster, wallboard, plywood and other materials within the limitations advised by manufacturers. The wall surfaces should be smooth. Remove and patch loose and broken plaster; remove wallpaper, calcimine and all traces of loose, scaly paint or enamel to assure proper adhesion.

Guide lines: A horizontal starting point is provided by snapping a level chalk line completely around the room on all walls as shown in Fig. 29. This may be at the height of the wainscoting. The exact height of the line is determined by adding together the width of the field tile courses plus that of the base cap and feature strip, if these are to be used. This will avoid getting narrow widths of the tile at the floor level. The measurement is made from the lowest point of the floor if this is uneven or sloping. In a bathroom, a measurement also is made from the top edge of the bathtub. Then you compromise between the two measurements for desired results. Where individual base tiles or base molding are used over the tiles, you locate the starting line so that the lowest course of the tile will extend below the top of the base. Where interlocking metal tiles are to be used, a horizontal guide line is snapped near the floor level, as these tiles are applied by starting at the bottom and working upward.

A vertical plumb line also is snapped at the exact center of each wall, Fig. 29. Meas-



FIG. 32



HOW GLASS TILE IS INSTALLED

Photo & illustrations courtesy Pittsburgh Plate Glass Co.

ure the tile widths from this line to wall edges or corner molding. If this measurement indicates that very narrow portions of tile will come at these points, snap another vertical guide line a sufficient distance on either side of the original line to avoid this. The original line then is disregarded. Often it is advisable to mark horizontal guide lines across the tops and bottoms of windows so that courses of tile on both sides will be in alignment. Where a diagonal pattern of tile is desired, you snap a 45-deg. line which intersects the vertical and horizontal lines.

Adhesives for flexible and metal tiles: Adhesives should be applied at room temperature. They must be mixed thoroughly and spread uniformly over the wall to a

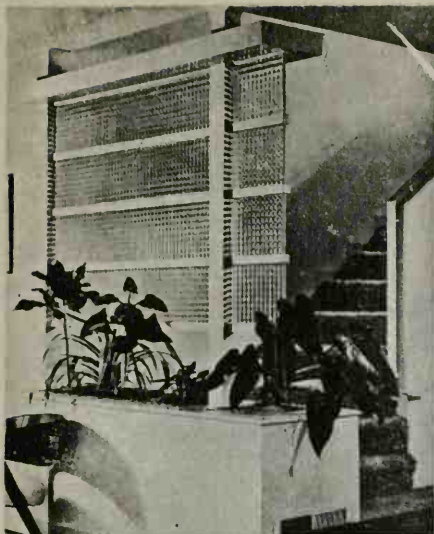
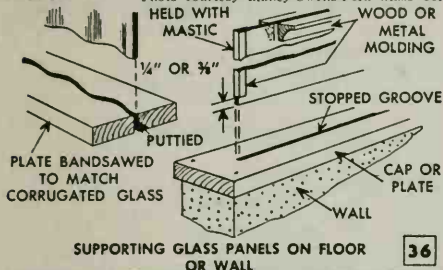


FIG. 34 Photo courtesy Libbey-Owens-Ford Glass Co.



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FIG. 35

Photo courtesy Mississippi Glass Co.

specified thickness by means of a suitably notched spreader as shown in Fig. 30. Adhesive is applied in different thicknesses as advised by manufacturers. Sometimes a rather large section of a wall can be covered with adhesive, but in other cases only a relatively small area can be covered, depending on how fast it dries. When spreading adhesive on a wall, avoid obliterating the guide lines.

Applying the tiles: Where corner molding is to be used, you install this first. Generally the application of tile is begun along the guide lines, working downward and toward one side. Sometimes tile laying is started from a straight and vertical corner molding. Rigid tiles should be snapped down on the adhesive as shown in Fig. 31. This forces some of the air out from behind the tile and creates a partial vacuum, assuring good adhesion. Before applying thin, metal tiles, they sometimes require flexing at the corners to make them lie flat. When doing this, avoid kinking the tiles.

Where a bead of adhesive is desired between tiles, you place them $\frac{1}{8}$ in. away from those already installed and then slide them in contact. This squeezes some of the adhesive into the joint. Placing the tips of four fingers on the surface of the tile, enables you to move it so that it will be square and tight against adjoining tiles. After locating the tile accurately, press it down at the corners. If too much adhesive has been applied, the center of the tile will bulge out. Pressing it down will force out some adhesive, but too much pressure is likely to leave a depression. Keep your hands clean of adhesive to avoid smearing

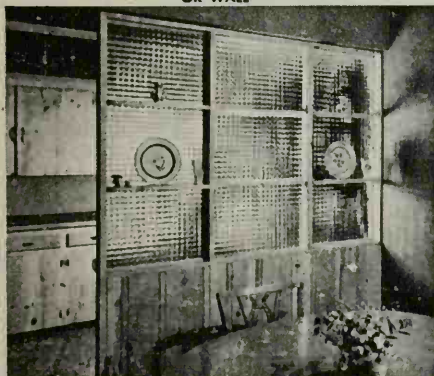
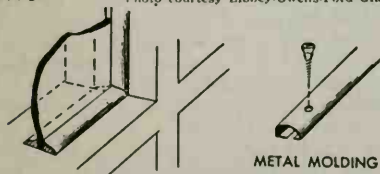


FIG. 37

Photo courtesy Libbey-Owens-Ford Glass Co.



METAL MOLDING

MOLDING TO HOLD GLASS PANELS IN FRAMES

38

it on the surface of tiles. At corners, floor level, pipe and fixtures, the tiles usually must be cut to fit.

"Pointing" of joints—getting the adhesive in neat, even widths slightly below the tile surface—is done as tiling progresses. First remove some of the adhesive between the tiles with a pointing tool, then wipe off the surplus with a clean cloth but avoid dragging it through the joint. Also clean the face of the tiles at this time. Rubbing a moistened finger over the joints will give them smoothness.

When recessed accessories such as soap dishes are to be installed, you cut the openings for them before laying the tile, but install the fixtures afterwards. You can drill through tile to fasten screw-on fixtures such as towel racks to the wall behind the tile. Don't fasten them to the tile itself. After installation of the tile, allow at least 2 weeks to elapse before attempting to polish it, which gives the adhesive time to harden thoroughly. Manufacturers' recommendations should be followed carefully in regard to cleaning solvents to use with any particular kind of tile.

Glass panels on walls: Wall glass in square or rectangular panels is available in many colors, sizes and in thicknesses from $1\frac{1}{32}$ to $1\frac{1}{4}$ in. Fig. 32 shows a bathroom wall covered with black glass squares. Wainscoting often is prefabricated to specifications, which includes drilling of holes to fit plumbing pipes and cutting for recessed fixtures. For new construction, the glass can be furnished mounted on plasterboard.

When remodeling, glass panels can be fastened to a solid plaster surface securely by using mastic as recommended by the glass manufacturer. After laying out guide lines as previously explained, heavy dabs of mastic are applied at intervals not over 12 in. on centers. Enough mastic is applied so that it will contact about half of the glass surface when the glass is pressed into place, with sufficient clearance between it and the edges of the wall. Before applying each piece, the edges are "buttered" with pointing compound to seal the joints. All pieces must be installed flush with adjoining ones, using a level to check for plumb.

Exposed edges like those at doorways as shown in Fig. 33-A, are covered with metal molding. This is not needed at corners as shown in detail B, nor at wainscot edges, detail C. The glass can be extended to the subfloor, and the finish floor laid against the glass surface as in detail D. Where glass panels are installed on a ceiling, they should be drilled for screws, which are driven through dabs of mastic and into level joists or furring strips. Rosettes are used under the screw heads and suitable bushings in the holes. Considerable care

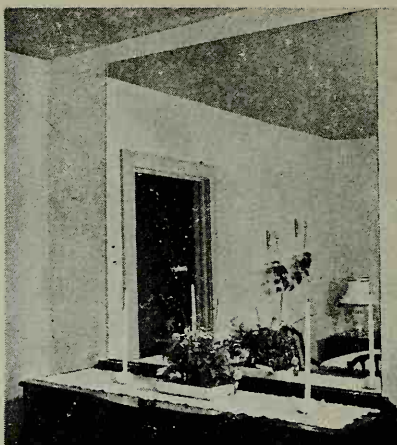
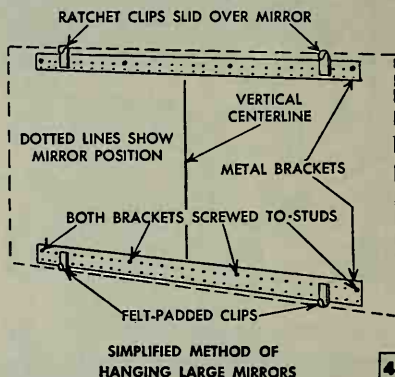


FIG. 39

Photo courtesy Pittsburgh Plate Glass Co.



must be exercised to prevent driving screws too tight, which often results in glass breakage.

Glass partitions: For screens and partitions, decorative glass used as shown in Figs. 34, 35 and 37, can give your home that smart, individual touch. Decorative glass comes in large sheets of varying thicknesses. It may be frosted, textured, ribbed or corrugated; may be transparent or translucent. Glass panels should be located preferably where they are not subject to being easily damaged. In more exposed locations it is best to use smaller panels as shown in Figs. 34 and 37, protecting them with suitable framing. Large panels can be supported at top and bottom, and protected along the side edges as shown in Figs. 35 and 36. Where metal channels are used at edges, mastic is applied in the channels for adhesion. As glass expands and contracts with temperature changes, allowance for this should be made by avoiding tight fits between rigid supporting members. Usually a clearance of $\frac{3}{8}$ in. is sufficient at the

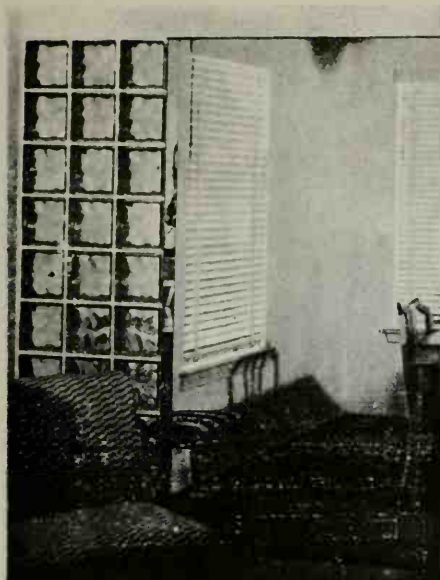


FIG. 41

top of a 7-ft. glass panel or partition. Wide partitions should have side clearance also. Small glass panels set in frames as in Fig. 37, are held in place with molding strips, Fig. 38.

Installing wall mirrors: Hanging large mirrors on walls, like those over fireplaces or above vanities, as shown in Fig. 39, can be done easily. Perforated metal brackets having felt-padded clips as in Fig. 40, are available for this purpose. The perforations permit attachment at almost any point along their length. This is done preferably with screws driven into studs. Toggle bolts can be used through plaster also. After setting the mirror on the lower clips, the upper ones are simply pushed down over the upper edge, giving firm support at four points. The bracket is entirely hidden by the mirror. Copper-backed mirrors are the most durable.

Glass blocks: When glass blocks are used for interior screens and partitions as in Figs. 41 and 42, they should be set on a rigid base. This may consist of two lengths of 2-in. stock toenailed edgewise to a floor, with a $\frac{3}{8}$ -in. filler strip between them as in Fig. 42-A. This allows for the attachment of a baseboard to match that of the room. Glass blocks should never be used for load-bearing walls. An exposed edge of a glass-block wall should be faced with an end cap of wood, metal or glass as shown in detail B.

Plastering: While new additions as well as old rooms may be finished completely

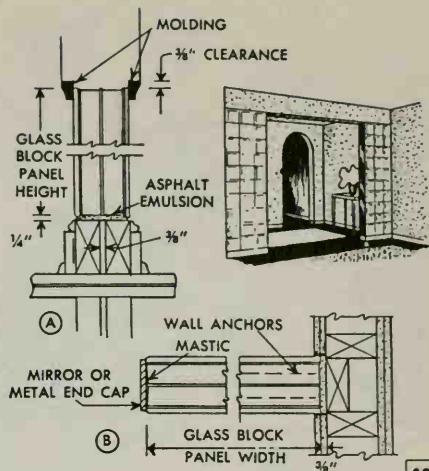


Photo & illustrations courtesy Pittsburgh Corning Corp.

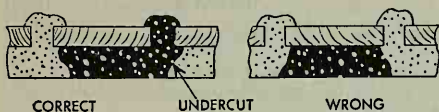
with dry-wall construction, many remodeling jobs necessitate plastering of walls. This may be largely repair work, where the old joins the new, and where walls have been opened, or it may include entire walls to match existing plastered walls. Any home owner can tackle a minor job of plaster repair, but major jobs of plastering should be left to professional plasterers. Before plastering, you remove all loose and crumbling old plaster, Fig. 43, and repair or replace plaster bases.

Small patchwork: For areas up to about a foot or so square, you can use patching plaster. Mix only an amount that can be used before it starts setting, which occurs in 10 to 30 mins. depending on the product. Setting can be retarded by substituting vinegar for half of the water. Undercut the edges of cracks and holes to make them wider at the bottom than at the top as shown in Fig. 44, which will serve to anchor the patch securely. Remove old plaster between lath to provide anchorage. Brush away all loose particles and soak the old plaster and also the plaster base if this is wood lath. Wetting prevents rapid absorption of moisture from the plaster, which causes poor adhesion. Press the plaster into firm contact with the undercut edges. As patching plaster may shrink somewhat upon drying, large patches often need two applications, 24 hrs. apart, to get a surface flush with adjoining plaster. Before painting over dry plaster, it must be sized. Small patches can be coated with thin shellac.

Plaster bases: For larger areas, you follow the same method of preparation as just described. Where extensive new areas are to be plastered, first apply a plaster base or lath, like panels of gypsum plaster base,



FIG. 43

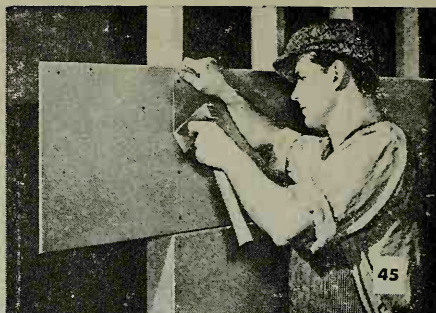


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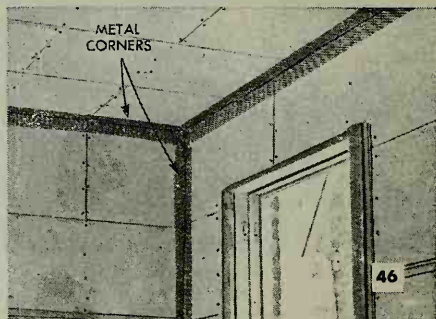
Fig. 45. This material comes in 16 by 48-in. sheets, $\frac{3}{8}$ and $\frac{1}{2}$ in. thick. Some types are perforated to give additional mechanical keying. For attachment, you use $1\frac{1}{8}$ -in., No. 13-ga. blued lath nails having $\frac{3}{8}$ -in. flat heads, spacing them 4 in. apart and using 5 nails at each stud. The sheets are placed horizontally, face side out, so that the ends come midway over studs. Vertical edges are staggered so that the joints of successive courses will fall on different studs. Gypsum lath should be used as a base for gypsum plaster only. Lime plaster and cement plaster will not bond with it adequately.

Besides gypsum plaster base, there are insulation-board plaster bases. Most plaster-base boards have V-type tongue-and-groove edges to resist troweling pressure. Some of these boards are coated on the back side to provide a vapor barrier. Before plastering, the inside corners of rooms should be reinforced with corner-covering strips, or with prebent strips of expanded metal lath as shown in Fig. 46. Reinforcing strips also are provided over upper corners of door and window openings to prevent subsequent cracks at these points.

Expanded metal lath is another type of plaster base. This comes in sheets 27 by 9 $\frac{1}{2}$ in. in size. On large walls the sheets are placed horizontally with all edges overlapping adjoining strips from $\frac{1}{2}$ to 1 in. Edges crossing studs and joists are held together with tie wires. The sheets should be staggered so that the ends will fall on different studs. Suitable nails or staples,



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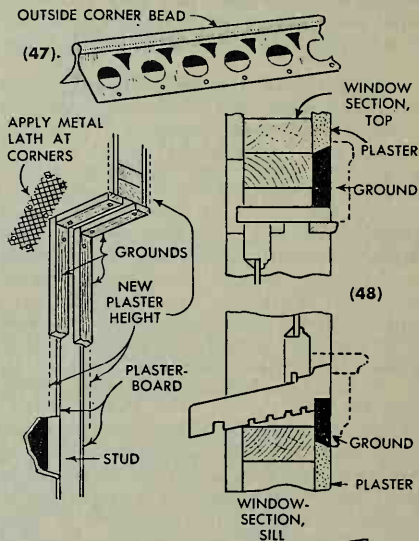


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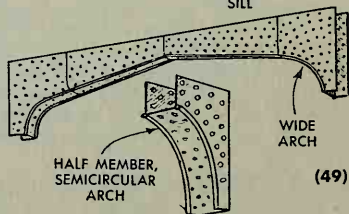
Photos courtesy U. S. Gypsum Co.

OUTSIDE CORNER BEAD

(47).



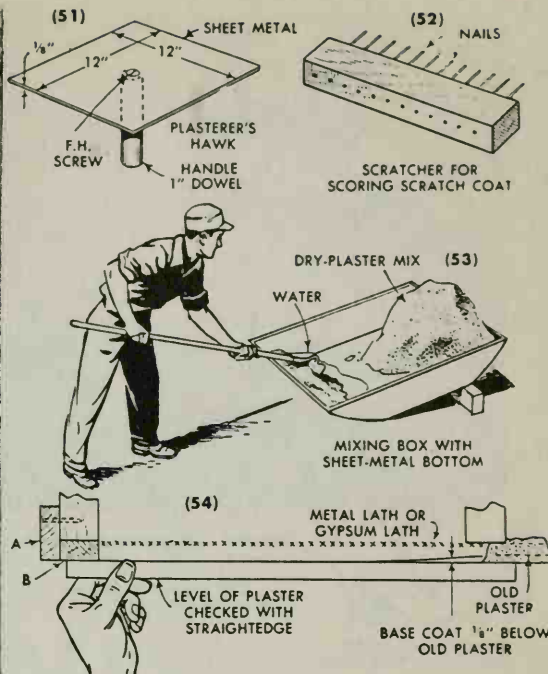
(48)



(49)



Photo courtesy U. S. Gypsum



spaced 6 in., are used for attachment.

Corner beads, grounds and metal arches: For outside corners over any type of plaster base, you use a corner bead, Fig. 47. This protects the plaster edge against impact, and also provides a "ground" to which plaster comes flush. It is attached carefully so that the corner will come exactly to plaster height of both adjoining walls.

Grounds at door openings are installed as shown in the left detail of Fig. 48, and are removed before installing the door jambs. Similar grounds are placed along window casings and also across studs to come just above floor level. These are left in place permanently. The edges of an existing wall serve as grounds for new plaster. The old plaster should be cut off as regularly as possible—not jagged—in order to make the joint as inconspicuous as possible.

Where arches are desired, readymade ones of perforated metal, Fig. 49, can be used. Rounded corner pieces, which are available separately, eliminate the difficult job of making curved frame pieces.

Ready-mixed plaster: Prepared plaster, requiring only the addition of water, is available. There are two kinds: base-coat plaster which contains either wood fiber or sand, and finish plaster. Gypsum-type plaster should not be used on exposed outdoor walls, on concrete or on asphalt coat-

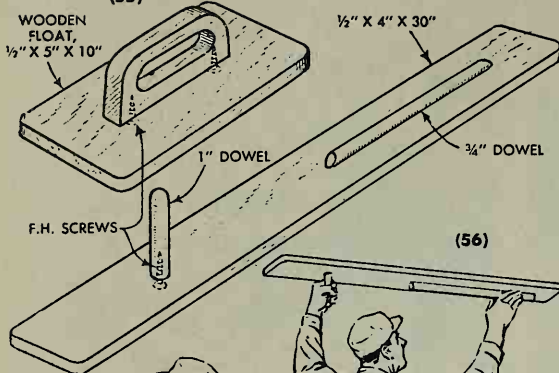
ings, or on walls subjected to excessive moisture. However, it can be applied to clean brick or to building tile, previously moistened.

Base coats: The standard minimum thickness of plaster for new construction is $\frac{5}{8}$ in. over metal lath, and $\frac{1}{2}$ in. over all other lath. However, in remodeling jobs the new plaster should come flush with the old plaster. Plaster is applied in separate coats; one coat of base plaster over gypsum lath, but two over metal lath, followed by a finish coat in each case.

Mixing plaster is done easily in a watertight box having sloping ends as in Fig. 53. By tilting the box at one end where the dry plaster is piled, you can mix quantities as needed at the other end. Use a hoe for mixing large batches and a garden trowel for small ones. Mix only as much plaster as you can use in an hour's time. Don't add water after the plaster has started to set, and don't mix plaster of a previous batch with a fresh batch. Put some on a "hawk," Figs. 50 and 51, to hold in the left hand, and apply the plaster with a plasterer's trowel.

When applying plaster to lath, press the first coat, called the "scratch coat," down to obtain good keying, or to form a good bond to gypsum-plaster base. Then cover the lath about $\frac{1}{4}$ in. Score crisscross grooves about $\frac{1}{8}$ in. deep while the plaster

(55)



F.H. SCREWS



(57)

WHEN SMOOTHING FINISH
COAT, APPLY WATER WITH BRUSH

LONG FLOAT, OR DARBY, FOR
LEVELING LARGE AREAS OF PLASTER



58

Photo courtesy U. S. Gypsum Co.

is soft, using a scratcher as shown in Fig. 52, or a piece of metal lath. After the first coat has set hard, apply a second coat as shown in Fig. 50, to come flush with the grounds. Where the new plaster joins old plaster, the edges must be soaked with water thoroughly to prevent rapid absorption of moisture from the new plaster. Soak the plaster and lath just prior to plastering.

It's best to keep the second base coat $\frac{1}{16}$ or $\frac{1}{8}$ in. below the surface of the old plaster along the joint as shown in Fig. 54. Run the corner of the trowel along the old plaster edge, and then "wipe" the plaster with the trowel back slightly, returning gradually to the plaster height of other grounds. This need not be done if a finish coat is not required. To get plaster level, use a straightedge across the grounds as in Fig. 54, which is called "rodding." For good adherence of the finish coat, the surface of the base coat should be slightly roughened by using a float as in Fig. 55. A long float, called a "darby," has two handles, Fig. 56, and is convenient for large areas.

Finish coat: There are two kinds of finish plaster; one for smooth troweling, and the other for a sanded finish for which a wood float is used. The base-coat plaster must be hard when the finish coat is applied. If dried out, moisten the surface with a wet brush, but do not soak. Finish plaster is "skimmed" on in two applica-

tions, Fig. 58, producing a coat from $\frac{1}{16}$ to $\frac{1}{8}$ in. thick. As soon as the first application has set enough to prevent its wrinkling, you skim on the second. When the plaster starts to set you can give it a final troweling to obtain a smooth, glossy finish, using a clean, wet brush ahead of the trowel as in Fig. 57, but using water sparingly. For an extra-hard surface, use Keene's cement in the proportion of 25 lbs. of dry, hydrated lime to 100 lbs. of Keene's cement.

Using trowel or float: When using a trowel or a float for smoothing plaster, move it sideways, lifting the forward edge a trifle so that it rides over the surface to avoid cutting into it. Keep the working surface of a trowel or float clean and smooth. The float should be dipped in water as necessary so it won't adhere to and drag out soft plaster.

Texture paints: Old, rough walls and ceilings that show many scars of previous patching jobs improperly done may be restored to excellent appearance by covering them with texture paint, provided that the old plaster is securely attached to the lath. Texture paints, available in many tints, are of heavy consistency to permit building up low spots to produce a uniform surface. The surface may be finished with brush marks, swirls, mottling with a sponge or crumpled paper, or it can be stippled with a brush.

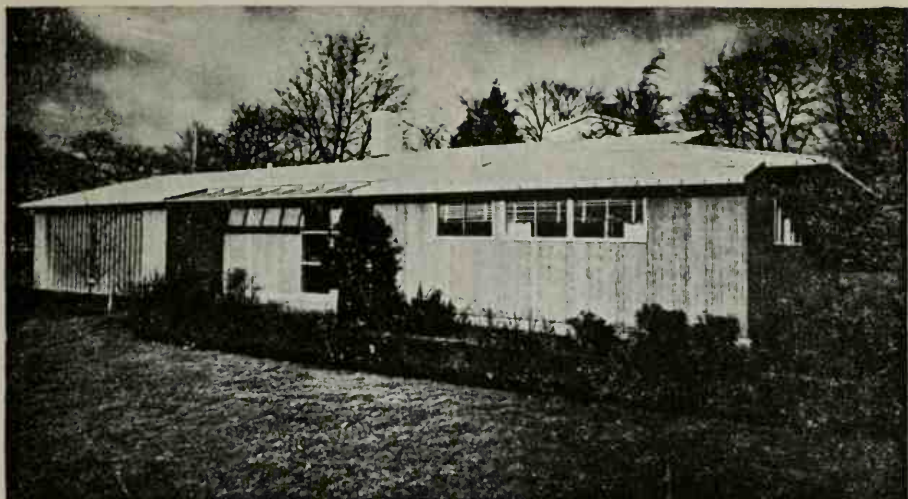


FIG. 1 Permanent color, which eliminates need of subsequent repainting, and beautiful, striated texture of this seemingly continuous wall covering of durable asbestos-cement board, gives pleasing variation from line design

Photo courtesy Johns-Manville

WALLS

MANY NEW and diversified materials now available for covering outside walls lend themselves to almost any kind of architectural treatment. A few examples are shown in Figs. 1 to 3.

Requirements for outside walls: There are four basic requirements for outside walls as indicated in Fig. 4. Walls must have (1) structural strength; (2) a high degree of resistance to infiltration of air, dust and free water; (3) insulation to retard the transfer of heat and cold; (4) a vapor barrier to prevent condensation of moisture within the walls in localities where cold weather is experienced.

Structural strength is obtained by the framework over which sheathing and covering are applied on the outside, and also by the wall coverings applied on the inside. Infiltration is reduced by wall coverings and with the use of building paper, which may or may not be required. Many sheathing boards are coated to give the same effect as building paper. Tight joints are essential to reduce infiltration. Therefore sheathing that has shiplap or tongue-and-groove joints is preferred. While restricting the penetration of air, all sheathing should allow the free passage of water vapor.

Insulation usually comes in the form of batts, blankets and quilts, or rigid compo-

sition boards such as sheathing, interior wall coverings and insulating plaster base. The batts or quilts have projecting edges for nailing to the inside edges of studs and joists before inside wall coverings are applied. A small space is left between the insulation and sheathing for air circulation.

As moisture contained in warm air inside of a house tends to move toward a cooler area or surface, it passes through inside wall coverings that are permeable, and also through the insulation. During cold weather the vapor condenses on the inside surface of the sheathing. As much as 2½ gals. of water may condense on each 1000 sq. ft. of sheathing per day if the inside wall is permeable to moisture. Such condensation causes many troubles such as deterioration of insulation, peeling of paint, rusting of nails and often even rotting of framework. To prevent such troubles a vapor barrier must be placed between the inside wall covering and the insulation as shown in Fig. 4.

Many insulating batts or quilts include a vapor barrier on the side that faces the house interior. In older houses that have no insulation, or those having blown-in insulation, a vapor barrier can be provided subsequently by applying two or three coats of aluminum paint to the inside walls before redecorating them. In older, unin-



FIG. 2

ulated houses having solid brick walls, a fair degree of insulation can be obtained and a vapor barrier provided by replastering on an insulating type of plaster base which is covered with a vapor barrier. An alternate method is to put a vapor barrier over old plaster, and then apply insulating-type wallboard. A brick wall can be covered on the outside for additional insulation.

Kinds of sheathing: Sheathing on outside walls may consist of wood, $\frac{3}{4}$ in. thick; exterior-type plywood, $\frac{5}{8}$ in. thick; composition board, about $\frac{3}{4}$ in. thick; and gypsum board, $\frac{1}{2}$ in. thick. Wood sheathing is usually applied diagonally as shown in Fig. 5, for maximum structural strength. Plywood and composition-board sheathing can be obtained in 4-ft. widths and various lengths. These may be installed vertically as in Fig. 6, or horizontally. Gypsum-board sheathing and some composition boards come in 2 by 4-ft. and 2 by 8-ft. panels, and are laid horizontally as shown in Fig. 7. Most sheathing boards intended for horizontal application have tongue-and-groove edges, and are placed with the tongue side up, or they have shiplap edges, which are placed so that water sheds to the outside.

Nails for sheathing: Wood sheathing boards that are 8 in. wide or less require two 8-d. nails at each stud. Joining ends should center on studs. To apply $\frac{5}{16}$ or $\frac{3}{8}$ -in. plywood sheathing, you use 6-d. box nails spaced 6 in. apart at edges and 12 in. apart on intermediate studs. For most fibrous insulating sheathing of about $\frac{3}{4}$ -in. thickness, you use $1\frac{3}{4}$ -in., 11-ga., galvanized roofing nails having $\frac{7}{16}$ -in. heads. For $\frac{1}{2}$ -in. thickness of some panels you use $1\frac{1}{2}$ -in. nails of the same kind. On wide panels



FIG. 3

Photo courtesy Kimble Glass Co.

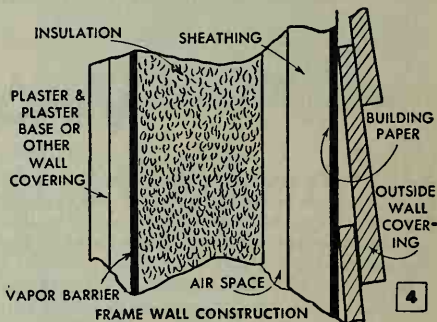


FIG. 5

Photo courtesy Arkansas Soft Pine Bureau



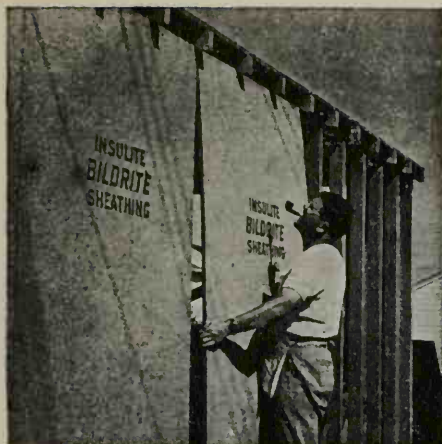


Photo courtesy Insulite Division, Minnesota & Ontario Paper Co.
FIG. 6

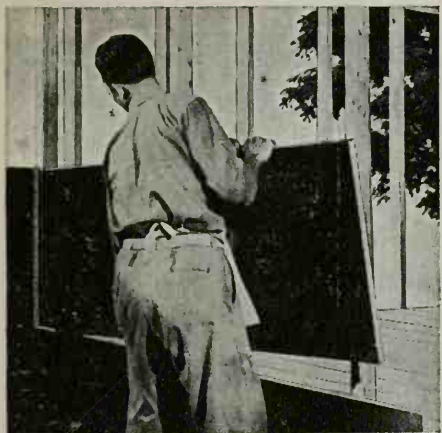
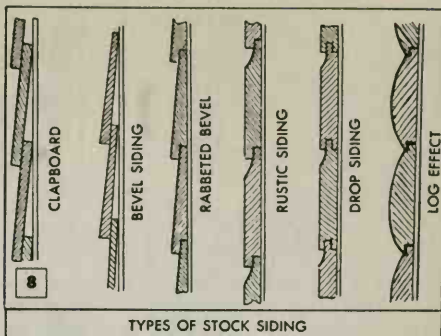


FIG. 7 Photo courtesy Celotex Corp.

nails are spaced 12 in. on intermediate studs, 6 in. along edges, and not closer than $\frac{3}{8}$ in. to edges. On the smaller panels the nails are spaced about $7\frac{1}{2}$ in., and not closer than $\frac{3}{8}$ in. to edges, using four nails at each stud. For gypsum sheathing panels similar nails, $1\frac{1}{4}$ in. long, are used the same way.

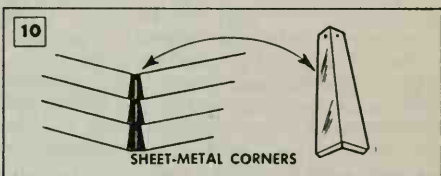
Building paper: Some manufacturers of exterior wall coverings make specific recommendations regarding the kind of building paper to use with their products. While building paper must be impervious to the passage of free water, it must permit the passage of water vapor. When laid horizontally each strip should overlap the one below by 2 in. When laid vertically the edges should overlap about 6 in. The paper should extend around corners for a distance of not less than 12 in.

Regular lapped siding: Fig. 8 shows sev-



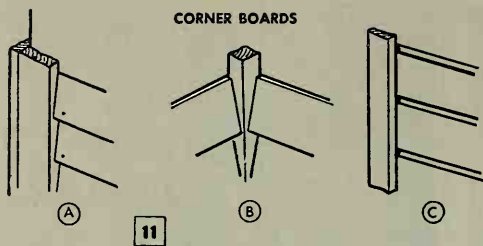
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OVERLAP OF BEVEL SIDING	
WIDTH OF SIDING	MINIMUM LAP
4"	$\frac{3}{4}$ "
5"	$\frac{7}{8}$ "
6"	1"
8"	$1\frac{1}{4}$ "
10" & MORE	$1\frac{1}{2}$ "



eral forms of stock wood siding, which comes in widths from 4 to 12 in. To apply bevel siding, you start at the bottom of a wall after nailing a $\frac{3}{8}$ -in. "cant" strip horizontally along the sheathing. This gives the first course the same flare as the rest. Each succeeding course of siding overlaps the one below it a distance given in Fig. 9. Sometimes siding is applied from the top down instead of from the bottom up. You nail through the butt or lower edge of each piece so that the nails will pass through the top edge of the piece underneath and into the studs. The nails are centered on the overlap. Use 6-d. siding nails for $\frac{1}{2}$ -in. bevel siding; 8-d. nails for $\frac{3}{4}$ -in. siding, applied directly over sheathing.

At corners you can have mitered joints, but these must be cut accurately to prevent entrance of water. Absorption of water at the ends of siding can be minimized by smearing them with calking compound just before nailing in place. Instead of mitering, you can cover corners with sheet-metal corner plates shown in Fig. 10, or you can butt the siding against corner boards as in Fig. 11-A and B. Mark the siding with a marking gauge as in Fig. 12 to assure tight fits. The application of corner boards over siding as in detail C is considered poor practice as water then can



collect in the pockets formed between the two. The joints where siding is butted together should be staggered as widely as possible from similar joints of adjoining courses. The joints should be centered over studs.

The lower edge of siding should line up with the tops of window and door drip caps, and with the lower edges of window sills as shown in Fig. 13. With this in mind you can vary the overlap slightly on a number of courses so that the adjusted spacing will not be conspicuous. Avoid hammer marks on the wood. To prevent steel nails from rusting you sink them slightly below the surface with a nail set, and putty the holes. This is not necessary if you use aluminum nails as they are rustproof. They will avoid the expense of frequent repainting to hide rust stains, which more than compensates for their slightly higher cost.

Besides wood siding, you can obtain aluminum siding, having baked-enamel finish. One kind is applied by means of clips that are hooked over the upper edge of each piece and nailed to studs as shown in Fig. 14. Another kind is extended at the butt edge for nailing, over which the top edge of the strip below fits to form a leakproof joint. At corners each strip may be fitted with a metal corner piece, or long strips to simulate regular corner boards are used.

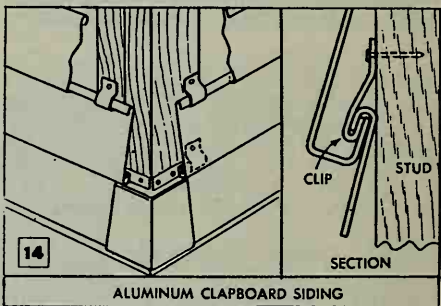
Wide, lapped siding: In addition to the striking effect obtained with wide siding in 12, 16 and 24-in. widths, large wall areas can be covered quickly with them. A number of materials are used for this purpose, which include $\frac{3}{8}$ -in. exterior-type plywood, $\frac{1}{4}$ -in. hardboard siding, and asbestos-cement board. Some of these have striated surfaces and come in various colors.

The courses are either simply overlapped for a distance of about $1\frac{1}{2}$ in., or they are overlapped slightly on "shadow strips." Both methods are shown in the upper details of Fig. 16. The lower edge of the first course, like regular siding, is raised on a cant strip so that this course will have the same outward angle as other courses. For support, shingles or similar wedge-shaped pieces of wood generally are placed vertically under each course at the stud loca-



FIG. 13

Photo courtesy National Gypsum Co.



tions as shown in Fig. 15. For 24-in. siding a horizontal strip of suitable thickness can be run under the center of each course as in Fig. 16. Shingles or wedges then are used only under the joints, the wedges being placed above and below the center strip. Nails are driven at stud locations.

The use of shadow strips, Fig. 16, accentuates the edges of the siding, which should

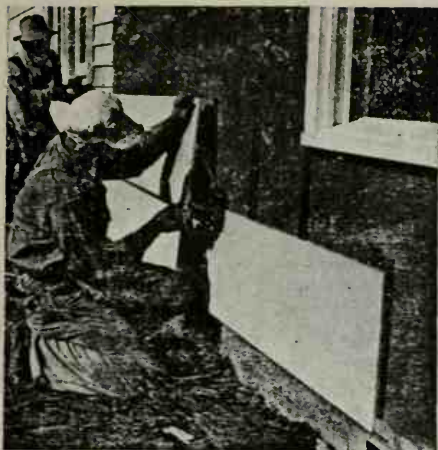


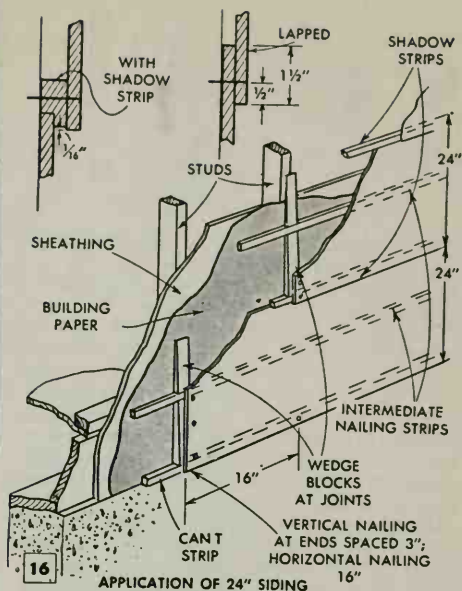
FIG. 15 Photo courtesy Douglas Fir Plywood Assn.

project about $\frac{1}{16}$ in. below them. Galvanized box or aluminum nails are used for attachment, the 10-d. size when shadow strips are used directly over sheathing, and the 8-d. size for plain lapped joints over sheathing. If sheathing is omitted, 8-d. nails are used with shadow strips; 6-d. nails with lap joints. When remodeling, the siding is often laid over existing siding after covering it with $\frac{1}{4}$ or $\frac{3}{8}$ -in. plywood of the exterior type. Then longer nails must be used than just specified; as much longer as the added thickness. Inside corners usually butt against square corner pieces in the same way as regular wood siding. Outside corners can be covered with metal corner strips. Corners of plywood can be mitered and glued, using waterproof glue.

Panel siding: Panels of exterior-type plywood, hardboard and other suitable composition-board siding, having either smooth or striated surfaces, can be butted together horizontally or vertically to produce a perfectly flat surface. Horizontal edges of panels must be flashed as shown in Fig. 17 to shed water, for which drip-type wood molding, details A to C, or metal molding, detail D, can be used. Shiplap joints, detail E, provide much the same protection.

Some types of panel siding are made to simulate stone, brickwork or shingles, as shown in Fig. 18. The panels usually come in 12, 16 or 24-in. widths, and in 48-in. lengths. They are applied horizontally, the long edges having shiplap or tongue-and-groove joints, which eliminate the need of flashing or applying molding. Special corner pieces are provided to match such materials.

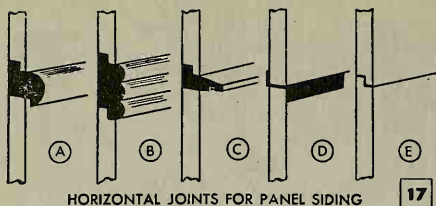
Vertical planking: Wood planks, exterior-type plywood and weather-resistant kinds of composition board in 16 and 32-in.



widths can be set vertically also. Vertical lines produce the illusion of greater height on low walls. Treatment of joints at butting ends on a wall or at corners is shown in Fig. 19.

"Plain" wall treatments: A modern variation from line impression of lapped siding or vertical planking is the plain treatment shown in Fig. 1. In this no joints are visible. In the case illustrated large panels of striated asbestos-cement board were set vertically. This material can be obtained in various colors, which eliminates the need of subsequent painting. It is practically indestructible under normal conditions of use, is fireproof and rotproof, and also gives added insulation. The panels are 32 in. wide, 96 in. long and $\frac{3}{16}$ in. thick. To facilitate nailing each sheet is perforated with $\frac{1}{8}$ -in. holes located along edges and at the center. The material can be scored and broken, or it can be cut with a large shears.

Shingles on walls: Shingles are nailed to wood or composition-board sheathing, or to 1 by 3-in. horizontal furring strips as shown in Figs. 20 and 21. Wood shingles usually are made of cedar, cypress or redwood in 16, 18 and 24-in. lengths. These lengths are exposed to the weather $4\frac{1}{2}$, $8\frac{1}{2}$ and 11 in. respectively. The 24-in. length is often used for walls. Shingles can be obtained already stained in pleasing colors, or they can be stained by hand dipping or by brushing them. Edge-grain shingles are more resistant to weathering and are much less likely to cup or warp than shingles cut flatwise.



HORIZONTAL JOINTS FOR PANEL SIDING

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Start shingling a wall at the foundation line, using a double row of shingles for the starter course. Spacing between the shingles should not be less than $\frac{1}{4}$ in. Use rust-resistant shingle nails, $1\frac{1}{4}$ long, two to each shingle and drive them about $\frac{3}{4}$ in. from vertical edges. The nails (3-d. size for ordinary shingles and longer ones for thicker shingles) are located a distance above the butts so that the following course will overlap them about $1\frac{1}{2}$ to 2 in. Special self-clinching nails can be obtained to nail shingles to composition board.

Joints between shingles in any course should not be less than $1\frac{1}{4}$ in. from the joints of the course below. The shadow lines of shingle courses should coincide with the upper and lower lines of window openings for appearance. This is possible by varying the spacing of the courses slightly as previously discussed under siding. A chalk line can be used for marking the butt location of courses, but it is easier to tack a 1 by 4-in. strip of wood to the wall as shown in Fig. 21, so the shingles can be set on it when nailing them. Shingles at inside and outside corners may join corner boards as in Fig. 11-A and B. At outside corners you can use metal corners, Fig. 10, or simply join the shingles of adjacent walls to form corners as in Fig. 20. This requires cutting them to fit. Corners of alternate courses should overlap each other in opposite directions.

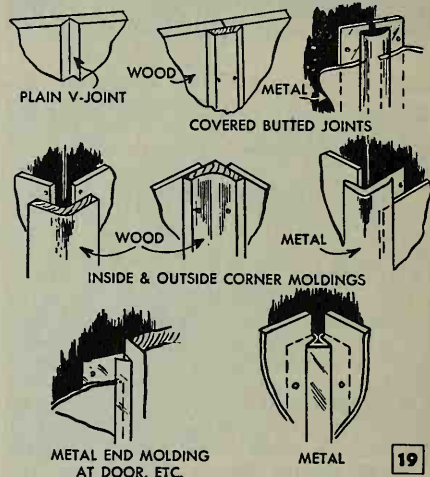
Shingles on walls may be laid in double courses, using a lower grade of shingles or composition-board shingle "backers" under those that are exposed. In this case the butts of the exposed shingles should project $\frac{1}{2}$ in. below the butts of the concealed course. Striking effects also can be obtained by using long shingles having irregularly cut butts or by using heavy shingles known as "shakes." Asbestos shingles, available in colors, also are commonly used for covering walls. Asphalt shingles also can be used for walls.

Recovering old walls: You can remove old siding and shingles before applying a new wall covering, or the new covering can be put over existing wall coverings. While the former method gives good results, the latter method keeps down labor costs and also adds to the insulating value of a wall. Putting a new covering over the



FIG. 18

Photo courtesy Insulating Siding Assn.



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old therefore is the customary procedure.

To remove old siding or shingles, you first strip off the old. Hammer down projecting nails, apply new building paper and then the new wall covering. However, don't remove all the old covering at one time as inclement weather can do considerable damage to the interior. The best practice is to tackle one wall at a time, removing and replacing a section at a time.

To add a new wall covering over siding or shingles a layer of $\frac{1}{4}$ or $\frac{3}{8}$ -in. exterior-type plywood is nailed on first to provide a flat surface. Furring strips are required over brick and stucco surfaces. Usually 1 by 3-in. wood strips are used although $\frac{3}{8}$ or $\frac{1}{2}$ -in. strips of plywood, 2 in. wide, are also suitable. Furring strips are placed either vertically or horizontally, depending on what material you use for recovering, and the manufacturer's recommendations. For lapped siding, furring strips should be vertical and spaced on 16-in.

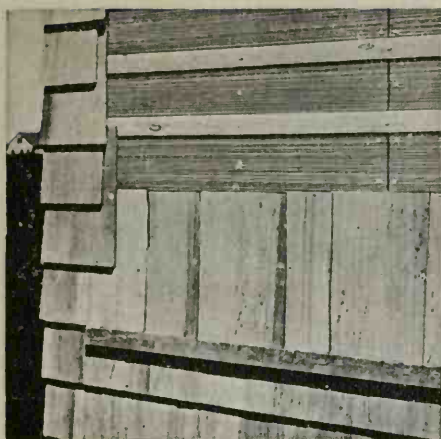
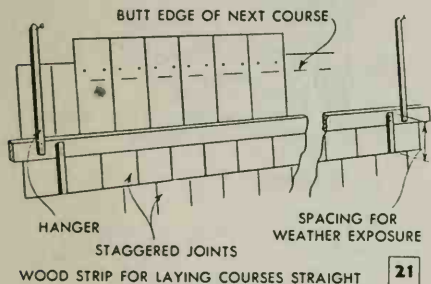


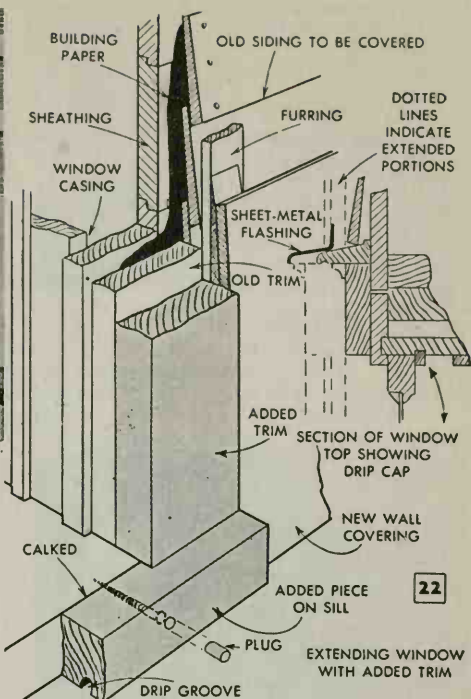
FIG. 20

Photo courtesy National Gypsum Co.



centers. For shingles, narrow wall panels and vertical planking the strips should be horizontal. For shingles they are spaced center to center the same distance as the amount of weather exposure of the shingles. Spacing for panels depends on their width. For stucco walls the furring strips are nailed so that the nails will penetrate studs. Nails through furring strips are spaced about 12 in. and should be long enough to penetrate into studs about $1\frac{1}{2}$ or 2-in. On brick walls you attach furring strips with 6-d. masonry nails driven into mortar between bricks. If this is too hard for penetration, or is too soft so that the nails do not have sufficient holding power, drill holes with a star or masonry drill for tight-fitting lead sleeves or wood plugs into which nails are driven. Screw anchors can be used also. Building paper is applied over the furring strips.

Extending door and window casings: When adding a wall covering over an existing one, the combined thickness will bring the new surface out beyond existing door and window casings. One way of solving this problem is to install wider casings. However, if the old ones are sound, it is sometimes possible to extend them as shown in Fig. 22 and thus avoid the ex-



pense of new casings. Casings in houses having brick, brick veneer or stucco walls can be extended in practically the same way. New corner boards generally can be applied over old ones. Trim at the roof may have to be removed but sometimes can be covered with new trim.

Covering with stucco: Stucco may be applied directly to masonry and old stucco that is in good condition, but it must be anchored to rust-resisting wire mesh when used over unsuitable masonry and over wood surfaces such as sheathing, old siding and shingles. It should not be applied to loose stucco, which should be removed. Water-resistant building paper must always be used over a wood backing to which the mesh is fastened.

Wire mesh to anchor stucco: To anchor stucco, don't use ordinary expanded metal plaster lath as this soon rusts out. Nail stucco reinforcing mesh in place with non-rusting nails such as aluminum or galvanized roofing nails as shown in Figs. 23 and 24. These are spaced about 12 to 16 in. apart and should penetrate the backing no less than 1 in. The mesh should be spaced from the backing at least $\frac{1}{4}$ in. so that the stucco will key behind it properly. Such spacing is possible by using washers on the nails or using special nails. Joining edges of the mesh are overlapped no less than 2 in., and

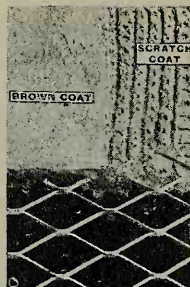
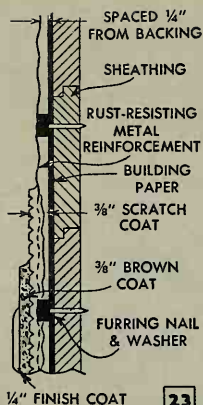


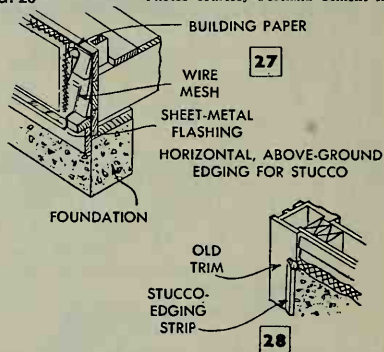
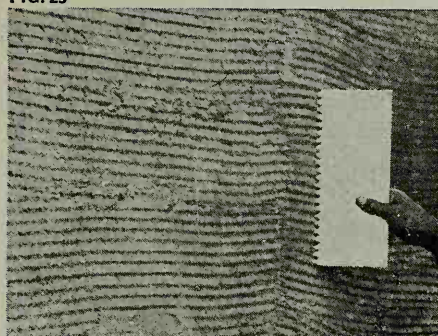
FIG. 24



FIG. 26

Photos courtesy Portland Cement Assn.

FIG. 25



wired together. The mesh should go around corners and over metal flashing. Don't use plasterers' metal corner beads for stucco unless they are the rustproof kind. Flashing should be used with stucco wherever there is any possibility of water getting under it.

Cleaning masonry for stucco coat: Stucco can be applied directly to unpainted hard or medium clay brick, but not to soft, disintegrating bricks. For the latter you use furring strips and reinforcing mesh. When stucco is to be applied directly to masonry, first clean off all paint, oil and dirt, which will prevent the stucco from adhering. For cleaning you use an acid solution consisting of muriatic acid, 1 part, slowly stirred into water, 6 parts, in an earthenware or glass container.

Apply the solution with a stiff fiber brush and wear rubber gloves and a rubber apron to prevent getting the solution on the skin and on the clothes. Acid burns may be serious, and the solution will disintegrate cloth. A few minutes after the acid has been applied you rinse away all traces of it with running water. Remove all loose mortar from the joints, raking them out

to a depth of $\frac{1}{2}$ in. for good anchorage.

You can purchase ready-mixed stucco which requires only the addition of water. It is mixed in a box such as is used to mix plaster as described in Section 11. Let the mixture stand for an hour before applying it. Stucco should be used within 3 hrs. from the time it is prepared if it is remixed without the addition of water. Before applying stucco to masonry surfaces, they must be moistened thoroughly with the fine mist from a hose nozzle. Stucco is applied in three separate coats; a scratch coat, a brown coat and then a finish coat. Each coat must be moistened before applying the next.

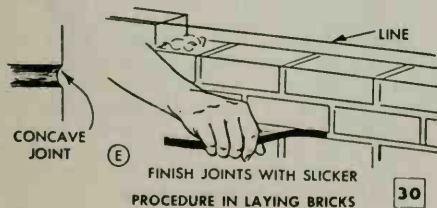
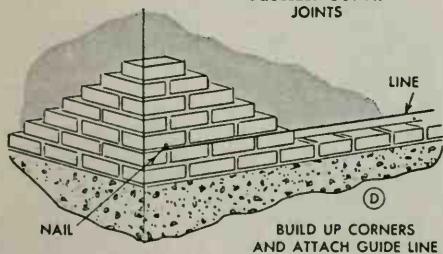
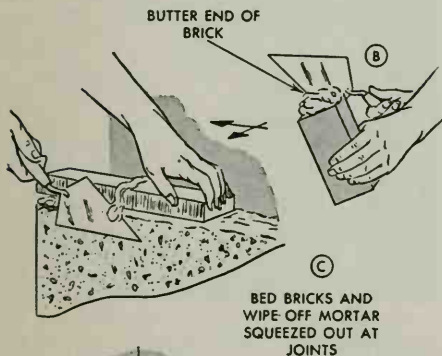
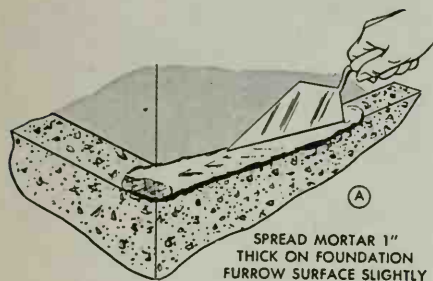
Application of stucco: Use a plasterer's hawk to hold stucco, and a trowel to apply it. Press it into firm contact with the anchoring surface. The first or scratch coat should be about $\frac{3}{8}$ in. thick, and is raked as shown in Fig. 25 to produce a grooved surface. Horizontal raking is preferable. From two to five days are allowed for curing, depending on the weather. Stucco should be kept moist while curing.

The second or brown coat also should be about $\frac{3}{8}$ in. thick, and is brought to a rela-



FIG. 29

Photo courtesy National Gypsum Co.



tively smooth surface by means of a long float or "darby" as shown in Section 11. Allow the second coat to dry for about a week and then apply the finish coat. This can be given any kind of surface treatment as desired. Fig. 26 shows a carpet covered float being used for finishing.

Never extend stucco down to grade level as moisture from the ground will damage it. A horizontal edging at the bottom of stucco consists of a strip of wood arranged as shown in Fig. 27. You install this with sheet-metal flashing (preferably aluminum) before nailing on the wire mesh. To compensate for the added thickness of stucco at doors and windows you can follow the method shown in Fig. 22. An alternate method is to use molding strips over trim to form an edging as in Fig. 28.

Brick-veneer walls: In brick-veneer construction, a 4-in. thickness of bricks forms a shell around the building framework. It does not carry any of the building weight. In no case should brick veneer be supported on a foundation separate from the foundation that supports the building.

The brick veneer is tied to the house framework by means of rustproof, L-shaped metal ties, such as the corrugated ones shown in Fig. 29. These are laid in mortar and attached with nails driven through the sheathing and into studs. Ties are placed at vertical intervals of about five courses of bricks, or about 15 in., and not over 24 in. apart horizontally.

Bricks and mortar: When handling bricks be sure to wear canvas gloves. Standard building bricks are 8 in. long, $3\frac{3}{4}$ in. wide and $2\frac{1}{4}$ in. thick. For each cu. ft. of masonry having $\frac{1}{2}$ -in. joints, 17.4 bricks and about $\frac{1}{3}$ cu. ft. of mortar are required. Mortar can be purchased ready-mixed, requiring only the addition of water. If you mix it yourself, use 1 part of portland cement to 3 parts of clean, sharp sand, with just enough water added to give a soft, workable mix. If a more "buttery" mix is desired you replace from 10 to 15 percent of the cement with hydrated lime.

Bricklaying procedure: First, you lay a row of bricks on the foundation, spacing them $\frac{1}{2}$ in. apart. The spacing may be varied a little so that the bricks will fit exactly within the predetermined space limits. If the bricks still do not fit, use a half brick between the last two, and then respace the rest for uniformity. Mark the joint locations on the foundation, remove the bricks and proceed to lay them with mortar.

During dry weather, bricks should be dampened but not soaked by spraying them with a hose adjusted to a fine mist. The foundation wall also should be moistened similarly. Using a bricklayer's trowel, you

spread a layer of mortar about an inch thick on the foundation for a distance of one or two bricks, starting at a corner as shown in Fig. 30-A. After pressing the corner brick down into position so that the bedding joint will be about $\frac{1}{2}$ in. thick, you "butter" its end and also the end of the second brick, detail B, with slightly more mortar than necessary to fill a vertical joint. Press the brick down in place toward the first one as in detail C, with a motion as shown by the arrows. After each brick is laid you remove the surplus mortar that has been squeezed out of the joints with a swipe of the trowel edge, and spot the mortar on the end of the brick just placed. Continue to lay the bricks in this way, getting them in perfect alignment with the marks on the foundation, all to the same height and with their front edges flush.

Working between corners: After the first course has been laid from corner to corner, you build up the corners in pyramid shape to the height of about 6 or 8 courses, detail D. Be sure that the corners are plumb. The vertical joints of each course come midway above the bricks of the preceding course, which takes place automatically by laying the end bricks at corners of alternate courses at right angles and into the adjacent wall.

When spreading mortar on a course of bricks, you'll soon learn to judge the right amount of mortar to apply. Run the trowel over it to form a shallow furrow. Beginners should not attempt to use more mortar for bedding than is needed for two or three bricks as the mortar should be soft and plastic when bricks are laid. A good bond will not be obtained if mortar dries out too much before bedding the bricks.

To get the courses straight and to the same height, you stretch a chalk line from the corners, tying it to nails pressed into the mortar. The line should come to the upper, outer edge of the course being laid. Holes left by the nails are filled up when the nails are removed. Besides using the line to assure alignment of bricks, you also check each course with a long level besides checking the wall vertically at every few courses to keep it plumb. The last brick laid in any course between built-up corners is the "closure" brick, which must be buttered at both ends besides spotting mortar on the ends of the bricks between which it fits.

Brickwork joints should be tooled carefully for appearance and to prevent water penetration. Do this before the mortar hardens. Of the many types of joint treatments, a concave finish often is preferred. This is produced with a round, tapered "slicker" as in Fig. 30-E. Use part of the rounded end that is slightly wider than the

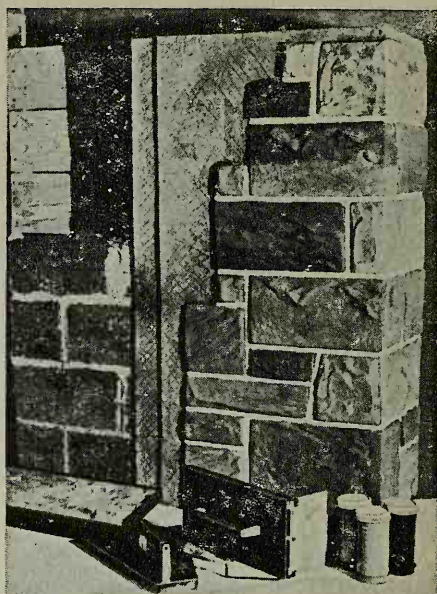


FIG. 31

Photo courtesy Perma-Stone Co.

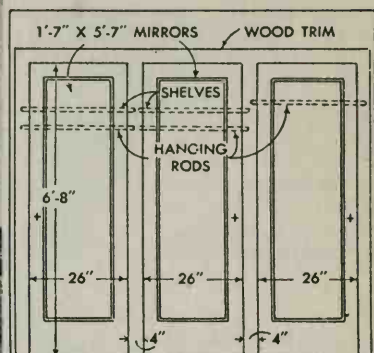
joint. Press the mortar tightly against adjoining bricks. This seals all cracks and smooths the mortar so it sheds water.

Stone veneer: Stonework is very much like brickwork in that the stones are laid in mortar, and the wall is similarly tied to the framework. Limestone in 4-in. thicknesses is available in random lengths and widths. Such precut stones involve much less trouble and require less time to lay than stones cut to size on the job.

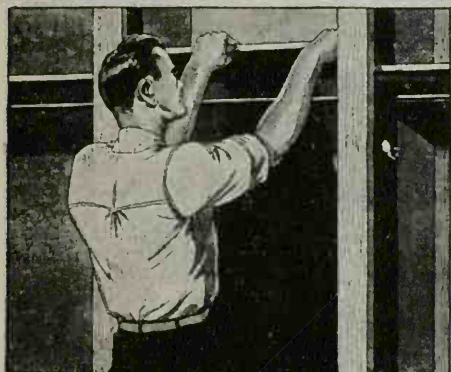
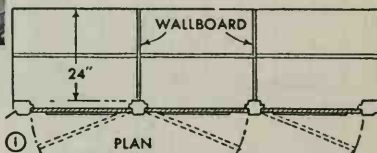
Closely resembling stone, concrete veneer, Fig. 31, often is used to obtain the same effect at much less cost. The concrete contains portland cement, quartz, waterproofing and hardening agents besides mineral colors. It is applied over a base coat of mortar on suitably prepared walls of brick, tile, concrete or cinder blocks. On frame construction, sheathing is first covered with 15-lb. asphalt-saturated felt and steel-mesh reinforcing to anchor the base coat. Each stone is individually cast in plastic state on the job by using molds. These are of various sizes and form a variety of patterns and surface textures.

Walls of glass: Glass blocks, which have considerable insulating value because the inside is a partial vacuum, can be used for large sections of walls as illustrated in Fig. 3. The blocks can be transparent for visibility or translucent for privacy. Glass blocks cannot be used to carry part of the weight in load-bearing walls.

WARDROBE



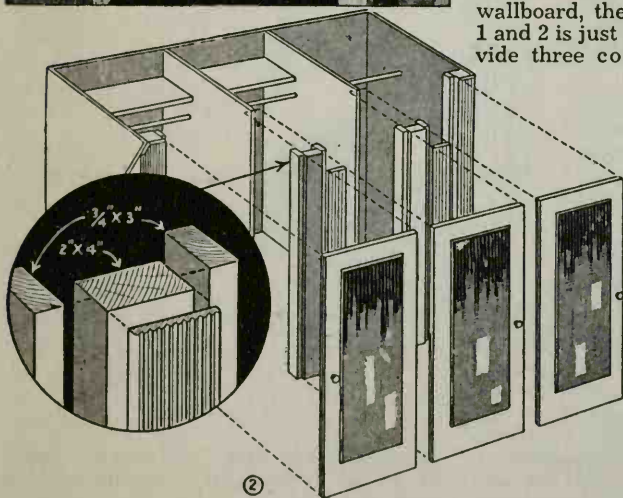
ELEVATION



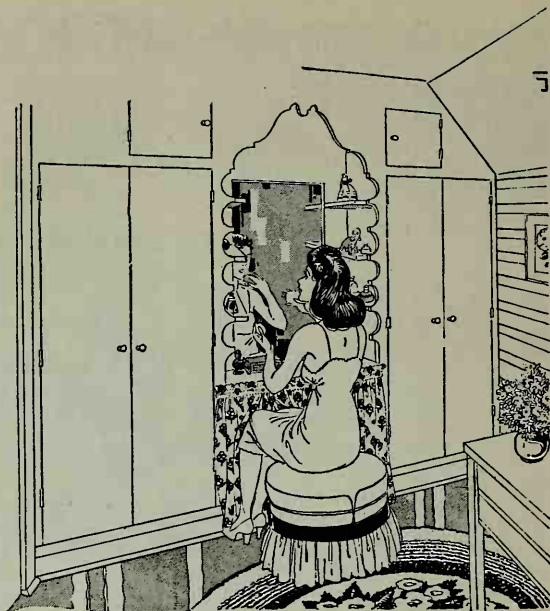
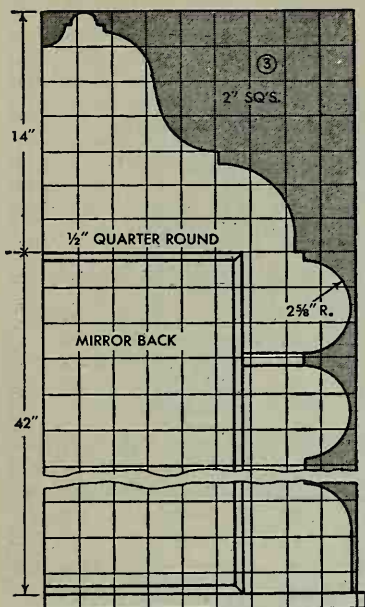
MANY of the problems of furnishing an attic bedroom and providing adequate closet space are solved by building in a wardrobe like the one shown above, or a vanity with wardrobe sections at the sides like the one shown on the following page. Used in the U. S. Gypsum Company's Remodel Research house, the wardrobe and vanity are easy to build, and they dress up a room, especially if it is long and narrow.

Faced with plaster board or other hard wallboard, the wardrobe detailed in Figs. 1 and 2 is just a simple framing job to provide three compartments or closets of

equal size, each being fitted with a mirrored door. Although plain flush or paneled doors can be used, the added attractiveness of the mirrored doors makes their extra cost well worthwhile. Since the width and height of your room will govern the size of the wardrobe, the dimensions given in Fig. 1 are only approximations and are intended as a guide in proportioning the one you build. As large panels of wallboard are used for the facing, back and partitions, the framework

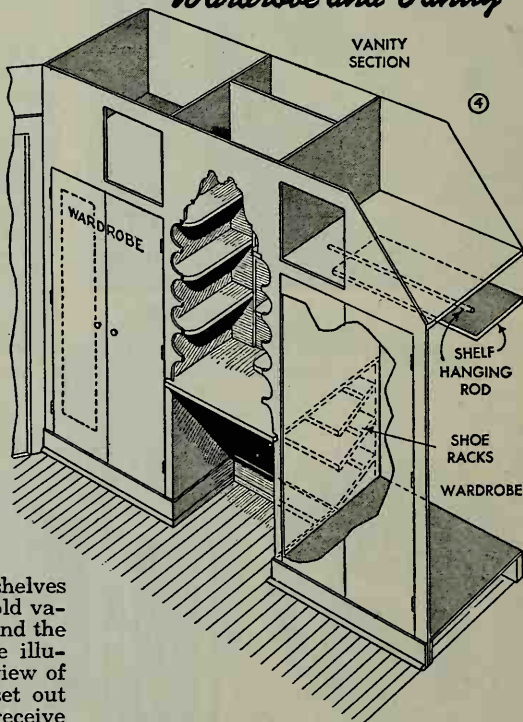


②



Wardrobe and Vanity

VANITY
SECTION



can be scantier than when regular wood boards are used. The circular detail of Fig. 2 shows how the doors are framed. The beaded trim is standard stock that can be obtained at most lumber yards. The shelves shown near the tops of the compartments are supported on cleats, and the hanging rods for garments can be supported by suitable brackets.

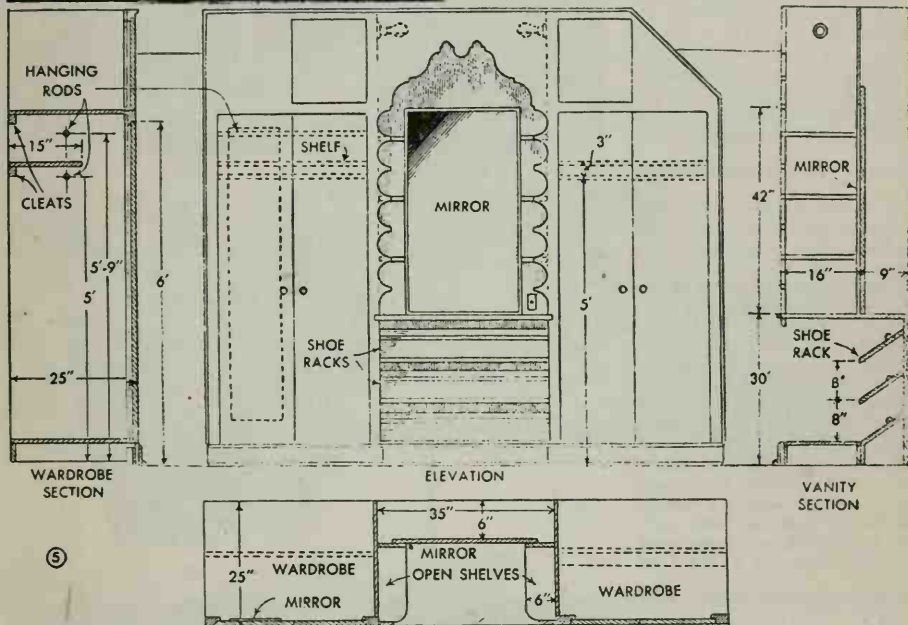
The vanity and wardrobe shown in Fig. 4 is ideal for a lady's room. It has a wardrobe at each side and storage compartments at the top. Overall general dimensions are given in Fig. 5. The size and shape of the scrollwork around the vanity portion is shown by the half pattern in Fig. 3. The skirted front of the lower section of the vanity hides handy shoe racks, and narrow shelves along the sides of the upper part hold various toilet articles. Two lights behind the scrolled front near the top provide illumination. As indicated in the top view of Fig. 5, the back of the vanity is set out 6 in. from the wall and is cut out to receive a large mirror, which is slightly larger than the opening so that it rests against the back where it can be held by a rabbeted frame

screwed to the back. The screws should be driven in from the front through the back and into the frame, countersinking



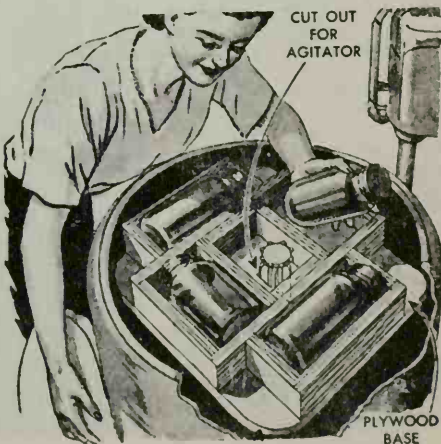
and putting the heads. Do this carefully so that the heads will not be visible after the back has been painted.

Construction and framing of the vanity are somewhat similar to that of the wardrobe except that the vanity has flush, double-hung doors for each wardrobe section and raised floors. Making the raised floors is just a matter of laying them over box frames that will fit snugly inside the wardrobe sections and then letting the ends and facing of the vanity extend down over them. Mitered baseboards and quarter rounds provide a finished appearance where the vanity contacts the room floor.



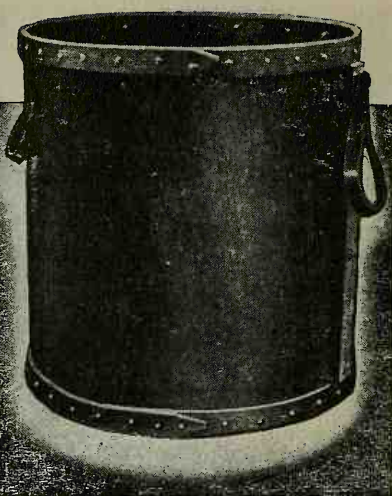
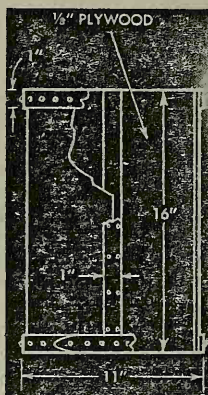
Butter Churn From Washer

Here is a way of converting your washer into a butter churn in just a few minutes. Cut a triangular hole in the center of a sheet of plywood so that it fits tightly over the agitator of the machine. Then assemble four separate compartments on the plywood base, making them $2\frac{1}{2} \times 3\frac{7}{8} \times 7$ in. to hold quart-size fruit jars. Fill the jars half full of cream to allow for expansion and fasten the lids tightly. Churn the cream by laying the jars in the compartments, as shown, and turning on the washer for the required length of time.

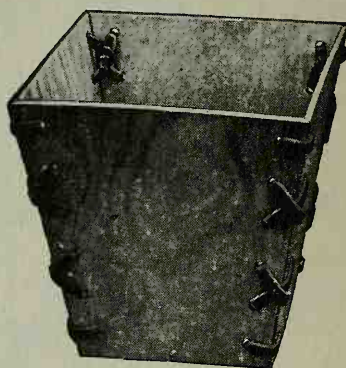
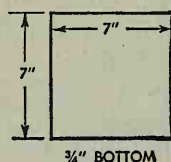
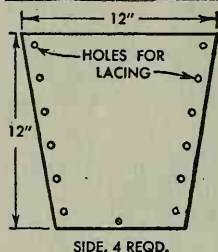


WASTEBASKETS

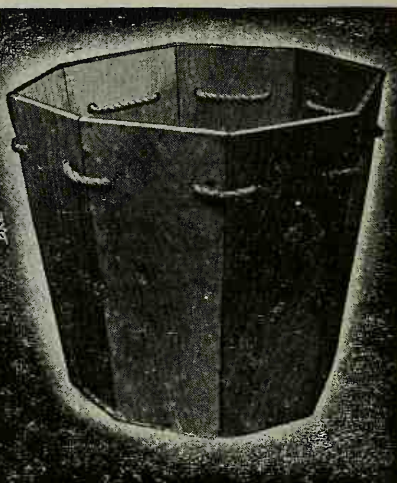
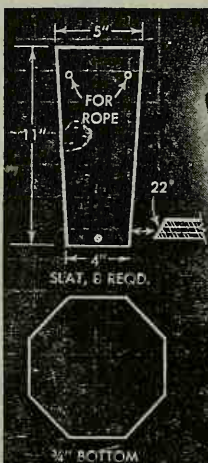
This basket was made from thin plywood salvaged from a shipping carton, although hardboard can be used. The bottom consists of a 10½-in. disk of ¾-in. wood around which the plywood is wrapped and fastened with small nails. The abutting edges of the plywood at the seam are faced on both sides with a plywood batten and nailed with escutcheon pins. Then the rim and bottom edge of the basket are covered with plywood hoops which are held with roundheaded gimp nails. The exposed ends of the hoops are tapered and lap about 4 in. The gimp nails at the top are clinched on the inside. Two strap handles complete the basket.

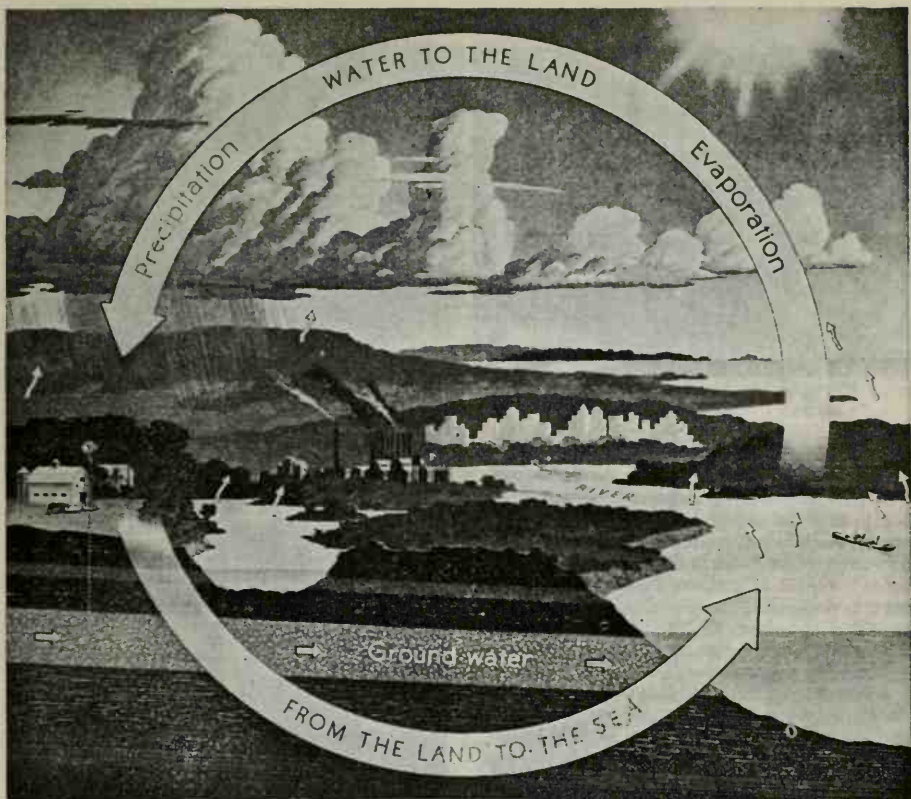


The utter simplicity of this five-piece basket will appeal to the beginner having few tools. The sides, being exactly alike, can all be sawed and drilled at one time from either plywood or hardboard. The edges are beveled 45 deg., and the bottom of the basket is a square piece of ¾-in. solid wood. Other than the screws which are used to attach the sides to the bottom, no metal fastenings are used, as the corners are laced together with a ¼-in. leather thong or a shoelace. Lacing is done in a manner similar to lacing a shoe, starting at the bottom and ending at the top with a knot on the inside.



Consisting of eight tapered staves screwed to a solid-wood bottom and laced together at the top, this basket is somewhat more difficult to make than the one described above. Here the edges of each stave are beveled 22 deg. to produce mitered joints when the staves are assembled. The edges can be sawed on an angle if a power saw is available, but if the beveling must be done by hand, the staves are cut out and then beveled with a plane. With the latter method, uniformity of the bevel can be assured by using a jig to support the stave at the proper angle and the plane horizontally. Sash cord or clothesline is used to lace the staves. The ends can be knotted on the inside or tied in a bow on outside. Finish all parts before assembling.





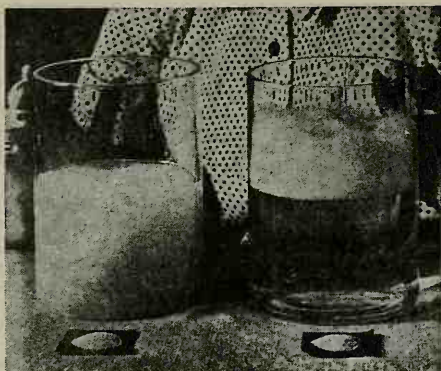
F.S.A.-Public Health Service, Division of Water Pollution photo

Water Conditioning

PURE WATER IS CLEAR, without taste, odor or color. Water in its natural state is never pure. Even rainwater, the closest approach to pure water, contains impurities collected from the air. When water seeps through the ground it absorbs minerals and gases of various kinds and in various quantities. These often cause water to become hard or impure and may render the water unpalatable and objectionable for domestic purposes even though it may not be contaminated. Assuming that a water supply is free from pollution, its improvement for other reasons often is desirable; it sometimes is necessary to make it fit for use. Most water correction by municipally operated plants is done for the purpose of sanitation. Some municipalities also soften water to some extent. However, such water can be improved further by home water-softening units.

Water that requires conditioning: Removing hardness from water is the most common form of water conditioning as the problem of hard water concerns about two-thirds of the population of the United States. In many sections it is necessary to remove iron, which causes staining and discoloration of everything it contacts. In sufficient quantities, iron also imparts a disagreeable flavor and affects the quality of beverages such as tea and coffee.

Other disagreeable tastes and odors in water may be due to organic matter such as sodium salts, chlorine, manufacturing wastes, algae, and dissolved gases such as hydrogen sulphide, which has a "rotten egg" odor and is corrosive. In small quantities, this water is not injurious when taken internally, but it can be dangerous in large quantities. Chlorine used in large amounts



Permutit Co. photos

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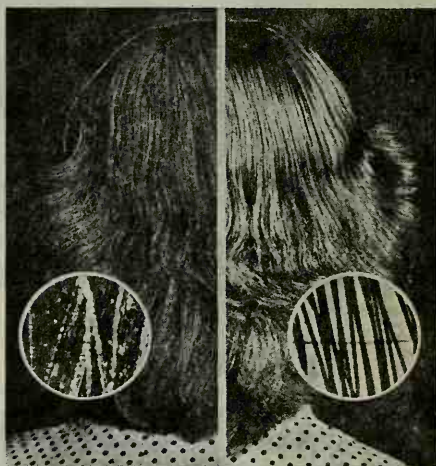
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for disinfecting water also produces a disagreeable taste.

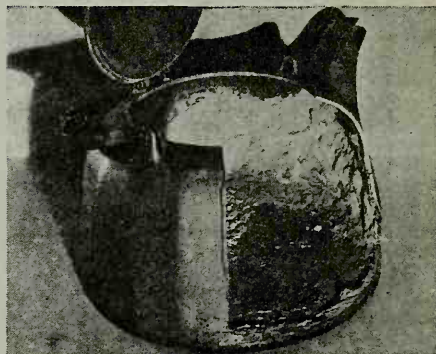
Objectionable appearance of water due to color and turbidity usually is caused by finely suspended matter such as clay, silt and organic matter. Soft water containing a large amount of carbon dioxide may cause severe corrosion in plumbing systems depending upon alkalinity. It is red and rusty in iron and steel pipes, and greenish (toxic) in brass or copper pipe.

Advantages of softened water: Water containing compounds of calcium and magnesium in large amounts is hard. The harder the water, the more it prevents the formation of suds and lather, whereas soft water produces suds readily. The amount of soap necessary to obtain satisfactory washing suds in hard water may be many times that required by soft water. This is shown in Fig. 1, where the same amount of soap was added to equal amounts of soft and hard water. The hard water at the left has practically no suds, while the soft water at the right has suds in abundance. Soft water can save as much as 75 percent in soap and detergent costs as indicated in Fig. 2. Much of the soap dissolved in hard water turns to sticky curds and scum, which adhere to plumbing fixtures, dishes, skin and hair. The difference in results between hard and soft water used for shampooing is shown in Fig. 3. The microphotograph at the left shows the scum deposits in the hair caused by hard water.

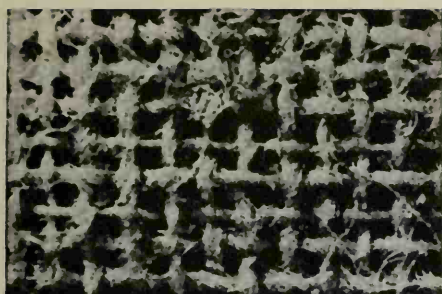
Clothes washed in soft water become cleaner, colors remain brighter, fabrics last longer. Hard-water scum is almost impossible to rinse out of fabrics; its retention causes rot and discoloration. The two microphotographs, Figs. 5 and 6, show the difference in the same textile washed in hard and in soft water. The one at the left shows scum deposits on and between the fibers. Dishes, glassware and silver washed in soft



3

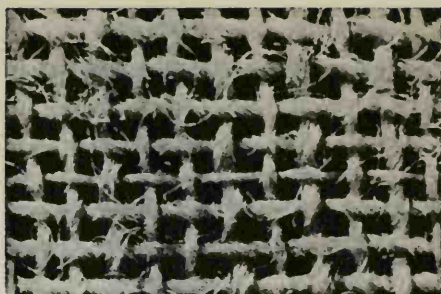


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Elgin Softener Corp. photos

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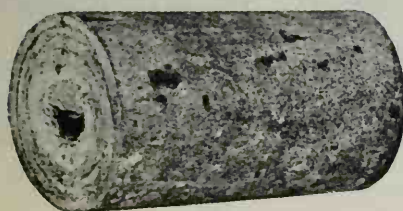
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water dry without the familiar streaks and spots caused by hard water. Manufacturers of automatic dishwashers urge the use of softened water for good washing results as well as the prevention of scale-and-scum accumulation on the equipment. In house cleaning, softened water often eliminates the need of using harsh soaps that may be injurious to wood and other finishes. It also prevents cloudiness and streaks caused by hard-water scum.

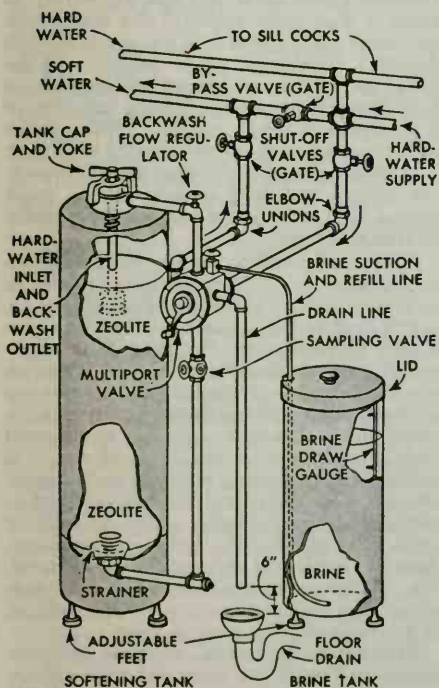
In food preparation softened water has distinct advantages; it produces better tea and coffee and does not toughen or shrivel beans, peas, lentils and some other foods which absorb calcium from hard water. Hard water boiled in a tea kettle coats it with a deposit of calcium as shown in Fig. 4. Softened water makes bathing more delightful, leaves the skin soft, the hair clean and lustrous, and eliminates the usual scum ring in bathtubs and lavatories.

Plumbing systems benefit from softened water as it does not coat the inside of pipes and water heaters with scale (liming). Fig. 7 shows how scale deposited inside of a pipe by hard water can eventually clog it, necessitating costly replacement. Scale in water heaters acts as insulation and increases water-heating costs.

Home water softeners: Various chemicals such as borax, washing soda, ammonia, limewater, etc., can be added to water to soften it to some extent for washing purposes. However, the most practical and economical method for the average home is a zeolite water-softening system, which provides water for drinking and culinary purposes as well as for washing. The cost and upkeep of such a water softener generally will be more than repaid by the savings of soap and detergents, increased life of fabrics, and decreased costs in plumbing maintenance due to limed pipes. A home water-softening unit consists of one or two tanks and is connected to the water-supply line so that all outlets, except the sill cocks for outdoor watering, are provided with soft water.

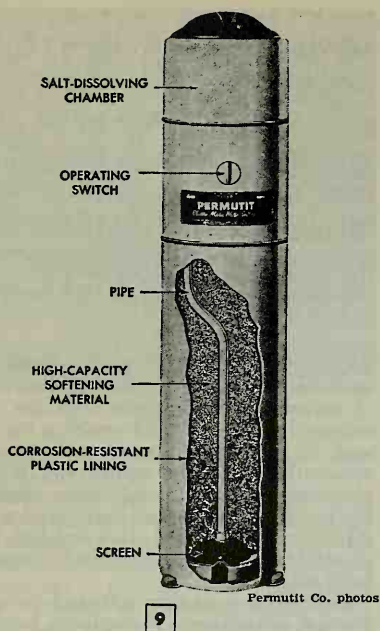


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TWO-TANK WATER-SOFTENING UNIT



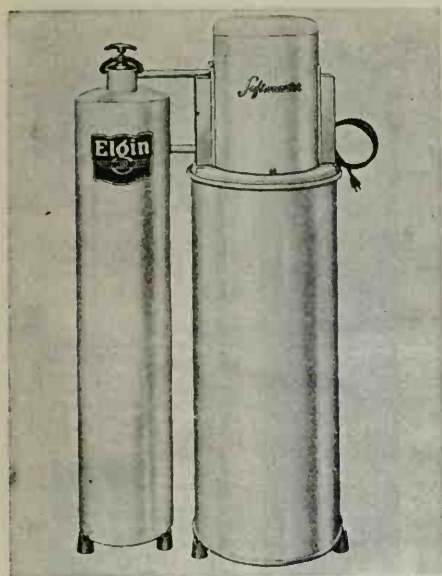
How zeolite water softeners work: Fig. 8 shows a typical home water softener of the two-tank variety. Hard water, admitted at the top, flows through a bed of zeolite, which is a mineral or a manufactured compound resembling sand, and is capable of removing the hardness from water without being consumed itself. It merely changes in composition by absorbing the calcium and magnesium compounds in water and liberating sodium. When the point of maximum absorption has been reached and the zeolite is no longer effective, it must be restored to its original condition (regenerated). This is done with a saturated solution of salt water (brine), applied in the correct amount and at the required rate to the zeolite, during which time the softener is shut off from the plumbing system. Water service need not be interrupted, however, since hard water can be supplied by bypassing the softening equipment.

The salt solution robs the zeolite of the calcium and magnesium, and restores its original sodium supply. Then the zeolite again is capable of softening water. The amount of water that can be softened between regenerations varies with the capacity of the unit, the amount of water used and its hardness. Regeneration involves the following steps: (1) backwashing to loosen the zeolite bed and to clean out deposited foreign matter; (2) salting; (3) slow rinse; (4) fast rinse; (5) refilling the tank; (6) returning the softener to service.

The zeolite is not soluble. It can go through repeated transformations indefinitely. Natural zeolite in mineral form resembles green sand and has the ability to remove iron from water if the concentration does not exceed 10.0 parts per million (p.p.m.). Synthetic white zeolite will remove up to 6.0 p.p.m. of iron and has at least four times the water-softening capacity of the green mineral zeolite. While water softening is the main purpose of zeolite, it is often combined with other water-correcting agents and sold under various trade names. The granules of various types differ in size and color.

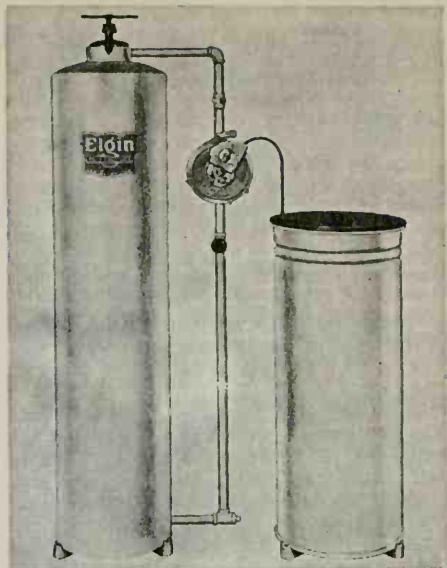
Types of zeolite water softeners: In single-tank or internal-salting types of automatic water softeners, Figs. 9 and 10, salt is first added at the top when it is necessary to regenerate the unit. Fine evaporated or granulated salt is used. Then an electric switch is pushed to start the process of regeneration which then is entirely automatic. In a two-tank softener the second tank contains brine, the level of which is maintained by adding water at each regeneration. Clean, coarse rock salt, crushed to pea size, is periodically added to a brine tank. Fine salt is not used as it has a tendency to pack and restrict the brine draw. Fig. 11 shows an automatic two-tank softener. The brine tank requires the addition of salt only once or twice a year.

Semiautomatic units, such as the one shown in Fig. 12, are provided with a timer and valve control, which automatically stops the rinsing action after a predeter-



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Elgin Softener Corp. photos



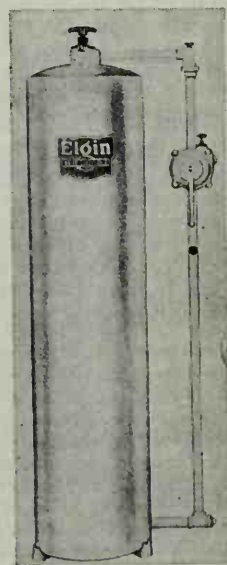
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mined period and returns the softener to service. In other models regeneration is controlled by manually operated valves, or by using a single multiport valve. Water softeners are heavily galvanized or are otherwise suitably coated or lined to eliminate or minimize corrosion. In some units the hard water enters at the top and flows down through the zeolite bed; in others, the direction of flow is just the opposite. Where iron must be removed from hard water, the flow should be down rather than up.

Other water-correction equipment: Other kinds of home water-correction units (neutralizers, clarifiers and purifiers), which are similar in outside appearance to water softeners, also are connected to the water-supply line near its inlet. Most of these units consist essentially of a filter tank, as in Fig. 13. They are fitted with valves and piping—like a water softener—to permit periodic backwashing. This loosens and cleans the material through which the water passes. Water to be conditioned is fed into the tank from the top and is discharged at the bottom. The essential difference in units for various purposes is the filtering medium or material through which the water passes. Water-correction units may be used in conjunction with water-softening units, being connected either ahead or following them as may be required.

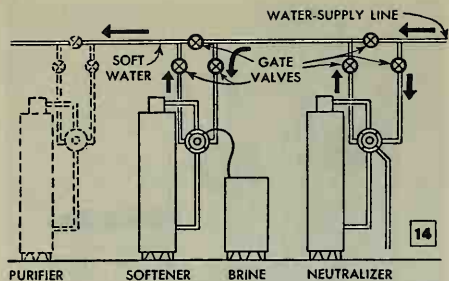
Acid neutralizers: Water that contains much free carbon-dioxide gas is very corrosive to iron, steel, brass and copper. When this water is heated, its corrosive action is

intensified. To remove the carbon-dioxide gas, the water is passed through a neutralizing material contained in a filter tank. Only a small quantity of neutralizing ma-



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terial is consumed and this is replaced annually to maintain the thickness of the bed. Acid neutralizers often are effective

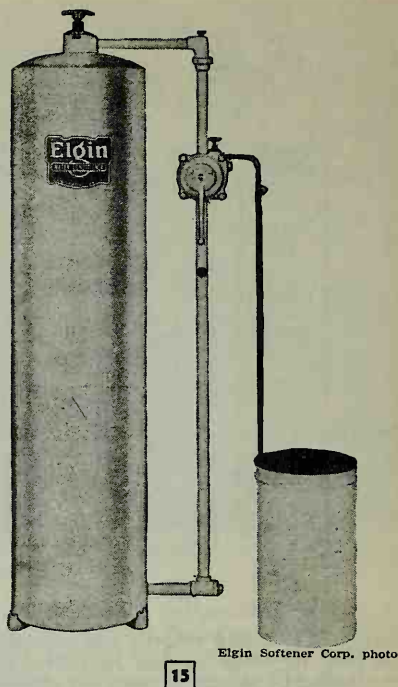


in removing some turbidity from water. When used in conjunction with water softeners, they are located ahead of them as shown in Fig. 14.

Taste and odor purifiers: Activated carbon or charcoal is used in a filter tank for removing or reducing unpleasant tastes and odors from water, such as fishy and marshy tastes frequently encountered, or the taste caused by heavy chlorination. Small amounts of hydrogen sulphide, which has a "rotten egg" odor, can be removed by activated carbon if this is renewed periodically. The best method of removing sulphur is by aeration, which may be accomplished with a degasitor. If this does not do the job completely some chlorine may have to be added to the water. If a carbon-bed purifier is used in connection with a water softener, it should follow the softener as indicated by the dotted lines in Fig. 14. This sequence will prevent foreign matter from clogging the carbon bed of the purifier. However, even with this protection, the carbon bed should be backwashed periodically.

Turbidity clarifiers: When water contains more than 30 parts per million (p.p.m.) of finely suspended matter, which makes it turbid, a clarifying filter is required, although such a filter may be desired even if the turbidity is less. A two-tank filter unit, as shown in Fig. 15, is used for this purpose. The filter tank is filled with various grades of filter quartz and sand, and the surface of the bed is covered with a gelatinous "filter mat," which stops and holds most of the impurities, and must be replaced periodically. An amount of coagulant powder is mixed with water in the smaller tank and is drawn into the larger one in the same manner that salt brine is drawn into a water softener. A filter of this type is not intended to remove iron. Where both water softening and clarifying are necessary, the clarifier is placed ahead of the softener to prevent excessive accumulation of dirt in the zeolite bed of the softener.

Size of softeners and filters: It is a common error to purchase a water softener of too small capacity. The proper size depends

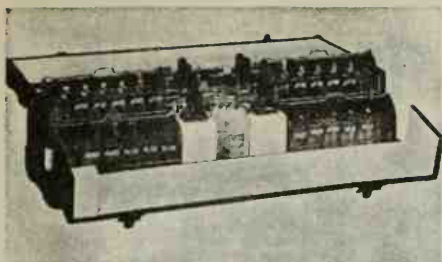


Elgin Softener Corp. photo

on two factors: (1) the amount of water used in the household, based on 50 gal. per person per day to cover all household requirements; (2) the character of the water as determined by a chemical analysis, which differs from a bacteriological analysis. A chemical analysis shows the impurities contained in water and its degree of hardness, and indicates what kind of zeolite must be used for softening and correction and if other water-correcting equipment is needed. The degree of hardness influences the amount of zeolite needed and hence the size of the tank. The harder the water, the more zeolite is required. Manufacturers provide tables that make it easy to determine the proper capacity of water-softening and conditioning equipment.

The successful operation of any kind of a water conditioner depends also on the rate of water flow in g.p.m., which must be available for backwashing, as may be required for the unit. If the water flow for backwashing is insufficient, the zeolite or filtering bed cannot be properly loosened and cleaned of the sediment that collects in it, which prevents the unit from functioning satisfactorily. A minimum pressure of 20 lbs. per sq. in. (p.s.i.) is necessary to backwash a water conditioner properly.

Determining water hardness: Where water is supplied from a municipal source, information regarding its character and



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RELATIVE HARDNESS OF WATER

Calcium (p.p.m.)	Description	Calcium (p.p.m.)	Description
15	Extremely soft	110	Moderately hard
30	Very soft	130	Hard
45	Soft	170	Very hard
90	Moderately soft	230	Excessively hard
		250	Too hard for use

degree of hardness can be obtained from the local water department. Where water is furnished by other sources, a chemical analysis is necessary, which is done free of charge by many manufacturers and mail-order houses. When sending a sample of water for analysis, the quantity should be no less than a pint and it should be sent in a clean bottle; dirt or traces of chemicals may influence the analysis. Many dealers of equipment for individual water-supply systems have water-testing kits, such as shown in Fig. 16, for making chemical analyses on the spot. The procedure is relatively simple and dependable if the instructions are followed carefully. A chemical analysis gives the degree of hardness, alkalinity or acidity and the predominant mineral contents. The degree of hardness is expressed in parts per million (p.p.m.) by weight of the calcium-carbonate content, or this is expressed in grains per gal., one grain being equal to 17 p.p.m. Fig. 17 shows how the calcium-carbonate content of soft and hard water varies.

Degasitors: Objectionable dissolved gases, including carbon dioxide, hydrogen sulphide, methane, besides other taste and odor-producing matter can be removed by aeration in a degasitor such as shown in Fig. 18. The water is fed into the top, is uniformly distributed by means of a manifold and is then broken up into fine sprays when cascading down a series of staggered baffles, through which a strong counter current of air is blown. The unit is entirely enclosed to prevent splashing and dispersment of moisture. When it is located inside a heated building, the unit is not affected by freezing weather.

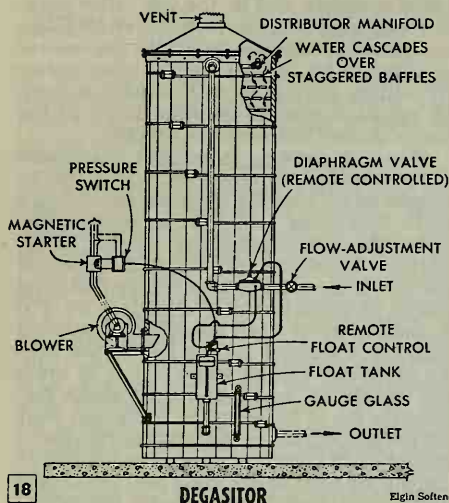
Iron removal: Large quantities of iron and manganese in solution can be removed

by first passing the water through a degasitor, then through a filter or a water softener provided with an iron-removing zeolite. Iron in water is held in solution by carbon dioxide. When such water is exposed to oxygen of the air, the iron oxidizes and precipitates as rust particles. Aeration hastens the process, whether this is done by a degasitor or by forcing the water through sprinklers or atomizing nozzles. The smaller the particles of water broken up, the more complete will be the job. After aeration the rust particles are removed by filtering. Aeration also eliminates the flat taste of distilled water and drinkable cistern water by adding oxygen to it. Precautions must be taken to prevent contamination of the water during the aeration process.

Where investment in aeration equipment is not justified, iron-bearing water can be improved for laundry purposes by adding a little limewater and stirring thoroughly. After the precipitated iron settles to the bottom, the clear upper water is drawn off for use. Limewater can be obtained at drug stores, or it can be made up as follows: Put a small lump of fresh quicklime (unslaked lime) in a wooden pail and slake the lime by gradually adding water about 30 times the weight of the lime. Stir or shake frequently for $\frac{1}{2}$ hr., allow to settle and pour off the liquid. Add to the lime residue about 300 times its weight of water, stir frequently during the next 24 hrs. and allow the lime to settle. The clear water above the undissolved lime is limewater; it should be kept for use in large well-corked bottles or carboys. There is some saving if the undissolved lime is bottled with the limewater. Every time some of the limewater is used, a like quantity of fresh water may be added as long as any undissolved lime remains.

Algae control: Greenish growths that produce scum and objectionable odor in stored water can be eliminated by treating the water with copper sulphate (blue vitriol), 1 oz. to 20,000 gal. of water. This concentration will not kill fish except trout, carp and suckers. A concentration of one-third the amount given is safe to prevent killing the latter.

Chemical feeders: Where water must be treated continually with chemicals, automatic feeding equipment, such as shown in Fig. 19, may be installed. An orifice in the water line permits feeding the chemical in proportion to the water flow, and the rate of feed is also controlled by means of a valve. Other chemical feeders may be motor driven or are connected to a water pump so that they work only when the pump operates. Small chlorinators so installed, as shown in Fig. 20, are available for private water correction. When it seems necessary to apply continued chlorination to a private

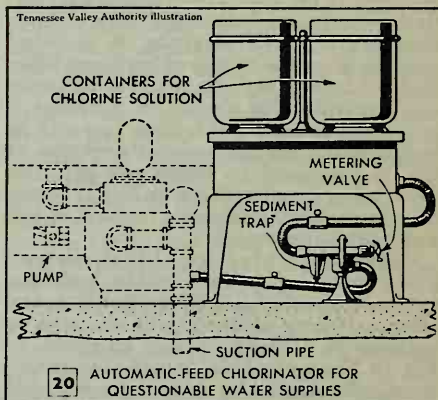
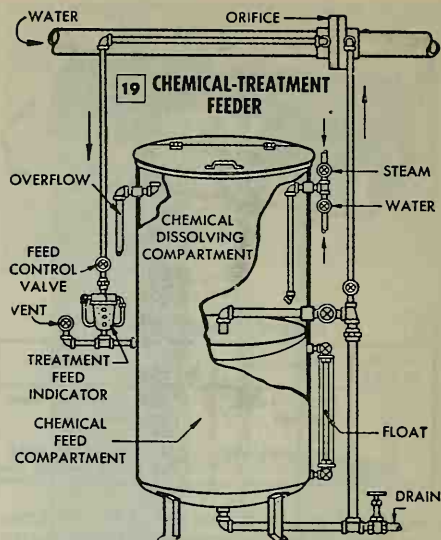


Elgin Softener Corp. illustrations

water supply, it is advisable to consult the county agent, state health department or a reputable manufacturer of water-treating equipment in order to ascertain the proper concentration.

Emergency sterilization of water: A simple and effective method of sterilizing water that may be unsafe is to boil it for not less than 5 minutes. Chlorine added to water will destroy most organisms, although amoebic dysentery germs can live in heavily chlorinated water as long as 15 days. Emergency chlorination of water is accomplished as follows: (1) Dissolve one heaping tablespoonful (approx. $\frac{1}{2}$ oz.) of chloride of lime in 2 gal. of water; (2) after mixing thoroughly, allow the solution to stand for 30 min.; (3) add one part of this solution to 100 parts of water to be sterilized; (4) let the chlorinated water stand for 30 min. before using, which gives the chemical time to be effective.

The chlorine content of water gradually diminishes until it disappears and is no longer effective. Waters of varying characteristics respond differently to chlorination;



those containing a high percentage of oxidizable matter often require larger doses to make them safe. Therefore absolute reliance cannot be placed on home methods of sterilizing water with chemicals.

WATER HEATERS

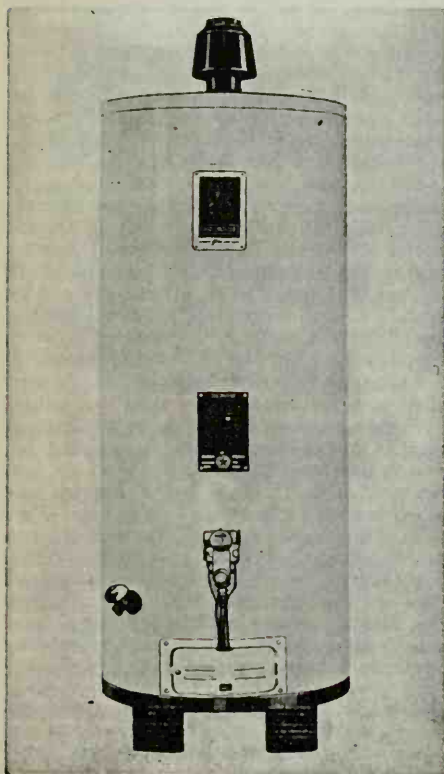
WHEN SELECTING A WATER HEATER the following considerations are important: (1) Size or capacity to suit requirements; (2) durability; (3) operating cost. It is assumed that the heaters considered are of good quality and are adequately insulated.

Size to suit requirements: Automatic heaters vary from small cottage units of 6 gal. capacity to larger home units of 80 gal. capacity. Fig. 1 shows a regular vertical model and Fig. 4 shows a cabinet model. The size of a heater determines largely how much hot water can be drawn off at one time or by a number of discharges in rapid succession. The service rating of a heater tells you the amount of hot water, heated 100 deg. F. above its original temperature, that can be drawn off intermittently per hour. It is the sum of the tank capacity plus the amount of water that can be raised 100

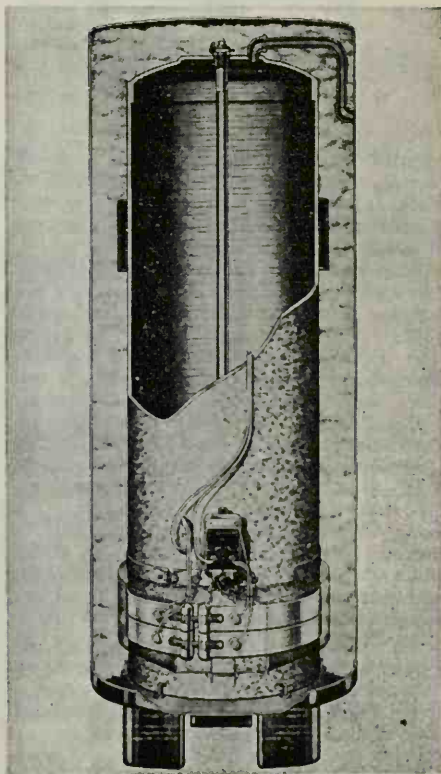
deg. in temperature in one hour. For example, an average-size 30-gal. unit that can heat 20 gal. of water to a 100-deg. temperature rise in an hour has a service rating of 50 g.p.h.

Family requirements for hot water can be estimated at 20 to 25 gal. per person per day, which includes water needed for household purposes. Automatic washing machines require from 20 to 30 gal. for periods of 30 to 60 min., and automatic dish washers use hot water at the rate of about $1\frac{1}{2}$ g.p.m., in loads of $3\frac{1}{2}$ to 10 gal. each.

Durability: The life of a water heater is usually measured to the time when the tank is eaten away by rust and becomes leaky or the delivery of hot water is greatly reduced by deposits of lime from hard water. In water heaters rusting is combated as follows: (1) By providing heavily gal-

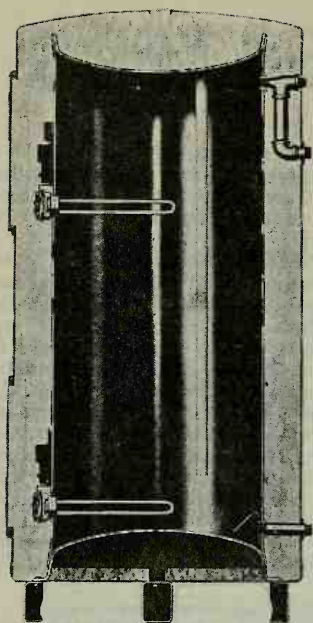


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McGraw Electric Co. photos

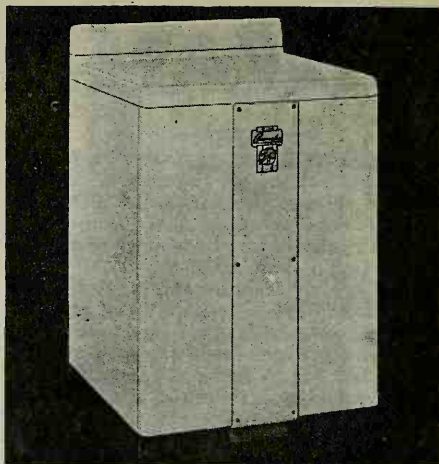


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vanized tanks; (2) by providing tanks of bronze, copper, Monel metal or glass-lined steel; (3) by using a magnesium anode in the heater tank, and (4) by artificially conditioning corrosive water.

Where water is exceptionally corrosive, galvanized tanks may start to rust in a few months. Bronze, copper and Monel-metal tanks are not generally subject to corrosion, although they are affected by some water-borne chemicals, but generally cost more than other tanks. Glass-lined tanks will not rust as long as the glass lining remains intact. This in some cases is flexible and highly resistant to blows and shocks. Magnesium anodes in hot-water tanks retard rust formation by electrolysis. The anode disintegrates slowly. Softening of hard water or correcting excessively corrosive water before admitting it to a plumbing system prevents lime deposits in pipes and water heaters and also minimizes corrosion.

Operating cost: Water heaters are designed to use electricity, natural gas, liquefied petroleum gas, oil or coal. The cost of these fuels varies in different localities. Therefore, it is advisable to check on cost of each before selecting a heater, if economy of operation is desired. In most urban communities the choice usually lies between electricity and gas.

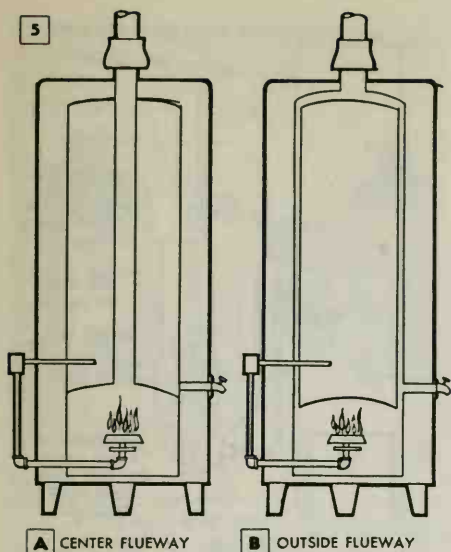


A. O. Smith Corp. photos

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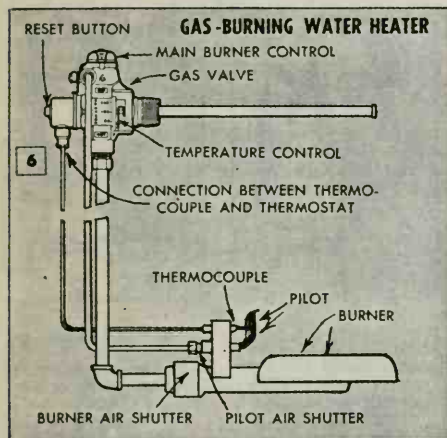
Automatic water heaters: Automatic heaters combined with tanks maintain a supply of hot water variable in temperature from 100 to 180 deg. F. Water at 140-deg. temperature is generally sufficient for household purposes. A thermostat extending into the water is used to control the heat source. If the control fails to turn off the heat, overheated water can escape through a safety-release valve. As automatic heaters are insulated, very little heat is lost by radiation. An automatic heater should never be connected to a furnace coil as such an installation may cause damage to the heater thermostat. Instantaneous automatic heaters have no tank; they heat water as it is used. The water passes through a small-diameter coil subjected to considerable heat which is turned on when a faucet is opened, and turned off when it is closed.

Automatic electric heaters: Automatic electric water heaters are safe and noiseless; they produce no fumes, smoke or soot. Heat is transmitted to the water either by one or two heating bands wrapped around the tank as in Fig. 2, or by one or two immersion units extending into it as in Fig. 3. In either case the heating elements are controlled by thermostat-operated switches that can be adjusted to the desired temperature setting. On double-element heaters the thermostat controlling the lower element may be set at a somewhat higher temperature than the upper one. Usually an over-temperature cutout is provided also, which breaks the circuit to the heating elements if for any reason the temperature becomes too high. The cutout must be reset before the heater will resume operation. An electric heater has no flue through which air circulates, and the tank can therefore



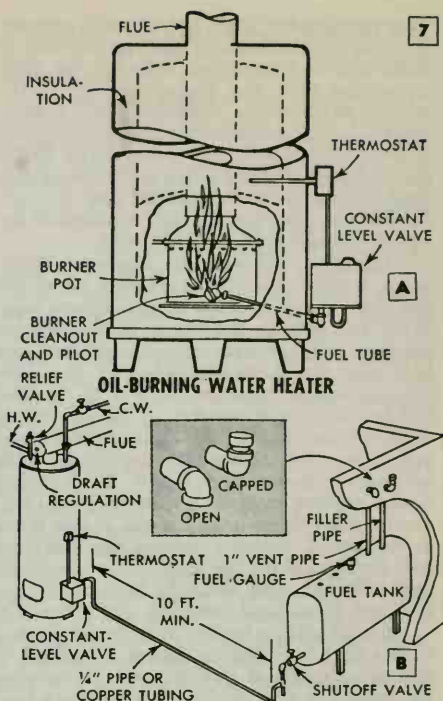
A CENTER FLUEWAY

B OUTSIDE FLUEWAY



be sealed completely with insulation. Thus water temperatures are maintained for longer periods than with other types of heaters. The recovery rate of electric heaters, however, is not as fast as that of gas heaters. To compensate for this, larger size electric heaters are used. The minimum recommended size is about 50 gal; the average size is 80 gal.

Automatic gas-fired heaters: In automatic gas-fired heaters the burner is located directly under the tank, the hot gases being discharged through a flueway. This may pass through the center of the tank, as in detail A of Fig. 5, or it may be located on the outside, detail B. A center flueway is equipped with a baffle that slows down the velocity of the rising gases so that more



heat will be absorbed by the water in the tank. The same purpose is accomplished in an outside flueway by means of a baffle-type draft diverter.

The gas valve that supplies the burner, Fig. 6, is turned on or off by a thermostatic element extending inside the tank, and is adjustable to maintain the desired temperature. A pilot light ignites the burner. Usually a thermocouple or bimetallic valve, heated by the pilot light, automatically cuts off the gas supply to both burner and pilot. This safety feature should not be overlooked when purchasing a gas water heater. When lighting such a pilot, a match is held under the end of the thermocouple for about 30 seconds, after which the pilot should light. About $\frac{3}{8}$ in. of the end of the thermocouple is kept in the pilot flame but should not be affected by the burner flame. The pilot air shutter is adjusted to produce a soft, blue flame from $\frac{1}{2}$ to $\frac{3}{4}$ in. long. The burner flame is adjusted in similar manner by mixing gas and air properly by means of the burner air shutter. The flame should be a soft blue, not yellow, and it should not have a hard blue center. Flame adjustments should be made after 5 min. of continuous burning.

Some thermostats have a manual reset button which must be pressed after the pilot has been burning for about a minute.

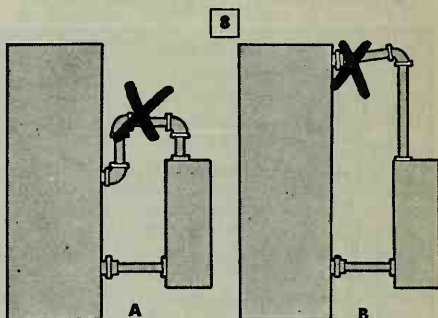
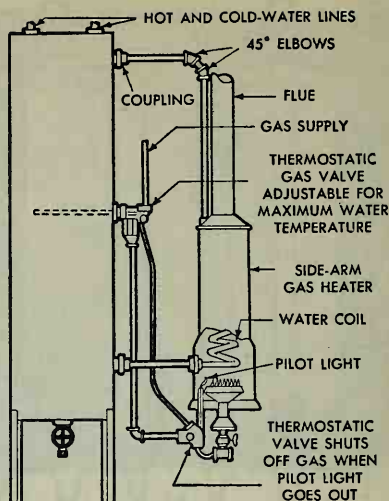
This permits the main gas valve to operate. If, after this procedure, the burner fails to light, a poor connection between the thermocouple and the thermostat is likely, which necessitates cleaning the contact point of the thermocouple and retightening it securely but without undue force. Burners and pilot orifices differ for burning natural, mixed or manufactured gas, and also for butane, propane and other liquefied petroleum gases sold in containers.

Automatic oil-burning heaters: Automatic heaters that burn oil may be of the pot type, Fig. 7A, or the power-driven type. With the former the flame is continuous, varying only in size from a burner flame to a pilot flame, as regulated by the thermostat, which controls the flow of oil. The hot burner vaporizes the oil, which mixes with air drawn through holes of the burner pot. The combustible mixture burns with a clear yellow-white flame. Oil-burning water heaters have center flueways of larger size than those used for gas. Some power-driven oil-burning heaters use less than half a gallon of oil per hour. They are clean and efficient, and entirely automatic, except for occasional cleaning and refueling.

An oil-burning heater may be connected to the fuel tank that supplies a furnace if the same grade of fuel is used. Otherwise the heater is provided with a separate fuel tank. In either case the tank should not be closer than 10 ft. from the burner; it should be provided with a shut-off valve, a fuel gauge, filler pipe and vent pipe. The latter two extend through an outside wall. See detail B of Fig. 7.

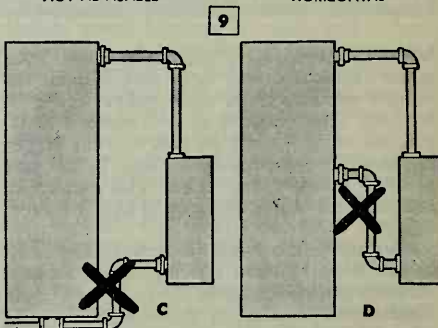
Other types of heaters: A side-arm gas heater connects to a water-storage tank or "range boiler" as in Figs. 8 and 11. It consists of a cast-iron or sheet-metal housing enclosing a single or double copper coil, and a burner. The manually ignited type is useful where hot water is required only occasionally. It is possible to make such a burner fully automatic by adding an approved thermostat and safety pilot, Fig. 8. Incorrect methods of connecting side-arm heaters to tanks are shown in Fig. 9. When the copper tube becomes coated with a thick lime deposit the coil must be replaced.

A water-storage tank can be converted to an automatic heater by installing an electric water-heating element combined with an adjustable thermostat, Fig. 10A. A hand-ignited, kerosene-burning heater, detail B, has a burner flame under a copper coil connected to the tank. A single needle valve controls the fuel supply. Coal-burning pot stoves, detail C, sometimes are used as auxiliary water-heating equipment where water is heated by a furnace coil or indirect heater during winter months. Disadvantages of pot stoves are that they require



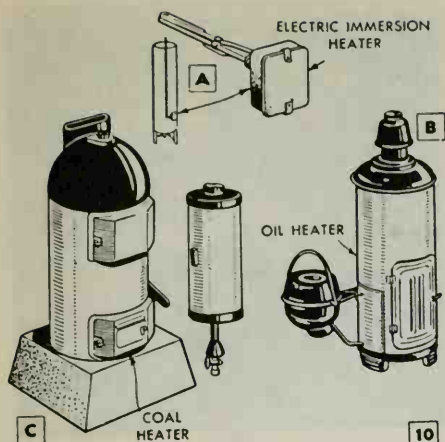
THREE 90° TURNS AND DOWNWARD FLOW OF HEATED WATER RETARDS CIRCULATION; CENTER CONNECTION TO TANK NOT ADVISABLE

DOWNWARD TRAVEL OF HEATED WATER TO TANK RETARDS FLOW. USE SHORTER VERTICAL PIPE TO GET UPPER ONE HORIZONTAL



COLD-WATER RETURN AT TANK BOTTOM PERMITS SEDIMENT AND RUST TO CIRCULATE WITH WATER; SEDIMENT WILL CLOG LOWER PIPE

COLD-WATER RETURN FROM CENTER OF TANK KEEPS LOWER PORTION TOO COLD AND UPPER PORTION TOO HOT



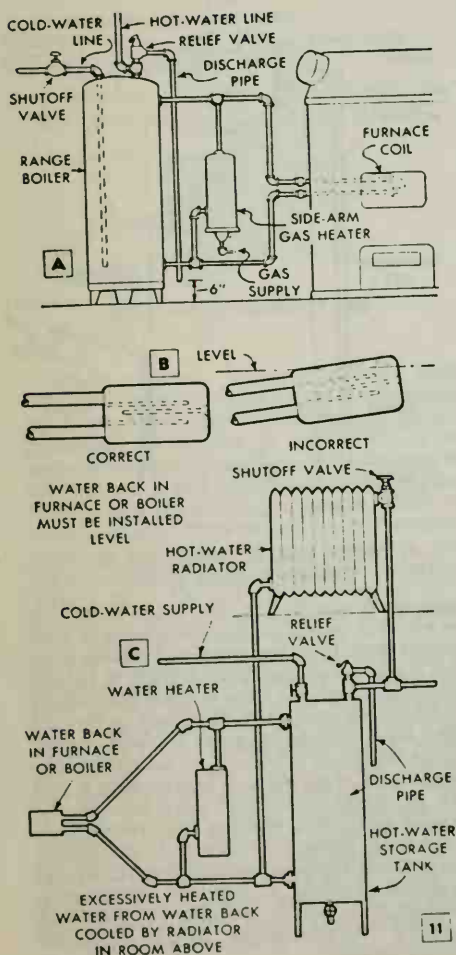
constant stoking and removal of ashes; also they are inexpensive only where coal is obtainable at low cost.

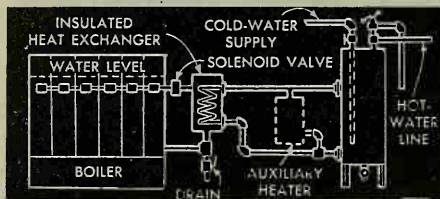
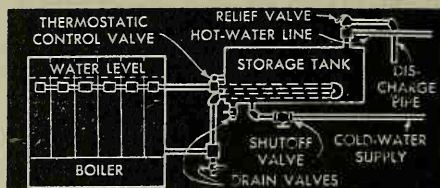
Furnace coils and indirect heaters: Furnace coils, also called water backs, still are found in many homes. Such a coil, Fig. 11A, can be installed in the furnace firebox of a coal, oil or gas-fired furnace. It is a misconception that a furnace coil utilizes waste heat; the heat it absorbs is taken from that normally used for warming the house—as much as 20 percent. Furnace coils become choked with scale in a relatively short time and generally require rather frequent cleaning. If cleaning is rather hard to do or is next to impossible they must be replaced. They should be installed level, as in detail B, to prevent the formation of an air pocket of live steam, which blows back periodically through the pipe and into the tank. This often causes violent hammering that may cause damage. Furnace coils generally overheat water during cold weather when a furnace operates at full capacity. Detail C shows a practical method of utilizing the excess heat by installing a radiator in a room directly above the hot-water tank. Although hot-water tanks are usually insulated to minimize heat loss by radiation, a tank that receives excess heat from a furnace coil may be left uninsulated. Insulating “jackets” for water tanks are available in various sizes.

Indirect water heaters or heat exchangers can be used on hot-water and steam boilers. Fig. 12 shows two arrangements for hot-water boilers, and Fig. 13 shows an arrangement for use on steam boilers. In any heat-exchange installation the input heat is controlled by a thermostatic valve to prevent overheating.

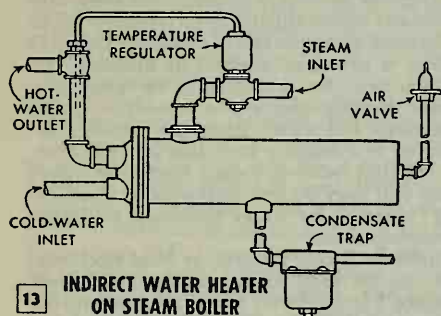
Installing water heaters: Fig. 15 shows a typical installation of an automatic gas-fired water heater. Manufacturers supply roughing-in dimensions such as shown in Fig. 17 so that pipes can be installed accurately to line up with the heater outlets. Any flame-type heater should be located where an adequate supply of air is available for combustion. Local codes in regard to the spacing of a heater and flue from combustible materials, as well as other requirements, should be followed carefully. A flame-type heater should be equipped with a suitable draft diverter or vent hood as in Figs. 15 and 16. This prevents chimney downdrafts from affecting combustion or blowing out the pilot light. Also, a flame-type heater should be located close to a chimney, and the flue connected to the chimney at a slope of not less than $\frac{1}{4}$ in. per ft. A 3 or 4-in. flue is large enough for gas-burning heaters, but a 4 to 6-in. flue is used for oil and coal-burning heaters.

A water heater should be set level. If the





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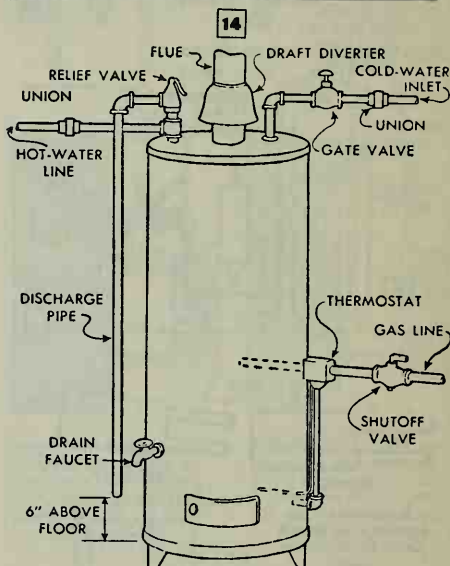


13

INDIRECT WATER HEATER ON STEAM BOILER

legs are not adjustable, or "jacks" are not provided to compensate for sloping floors, a concrete base 3 or 4 in. high can be provided. The heater outlets to which cold and hot-water pipes connect are generally marked; if not, the hot-water outlet is usually at your left as you are facing the front of the tank. The cold-water supply pipe should not be smaller than $\frac{3}{4}$ in., and should be provided with a shut-off valve near the tank. Some codes require a check valve in the cold-water supply line. The hot-water line from the heater should not be smaller than $\frac{1}{2}$ -in. pipe or $\frac{3}{8}$ -in. copper tubing. Unions are used to connect the tank pipes to the hot and cold-water lines of the plumbing system so that a tank can be replaced with minimum trouble when this becomes necessary. The drain or drip pipe from the safety control should never be connected directly to a waste pipe; a 6-in. air gap should be provided between them.

Some electric heaters have a built-in heat trap, as shown in Figs. 2 and 3, which prevents cool water in the pipe from backing up into the tank and hot water from circulating in the pipe. The principle can be applied to other heaters by arranging the



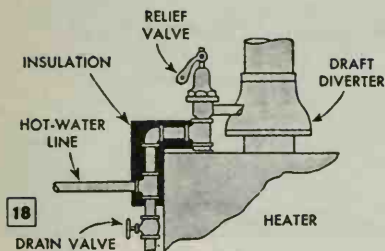
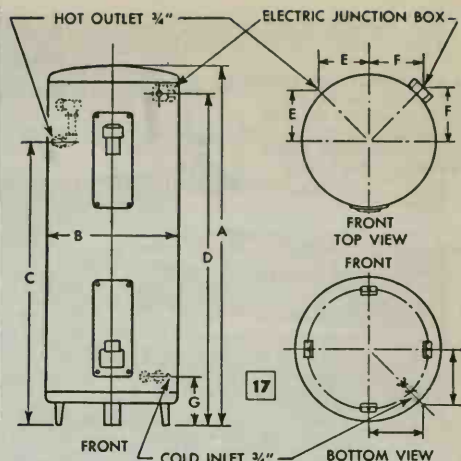
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WATER AND GAS CONNECTIONS TO AUTOMATIC WATER HEATER

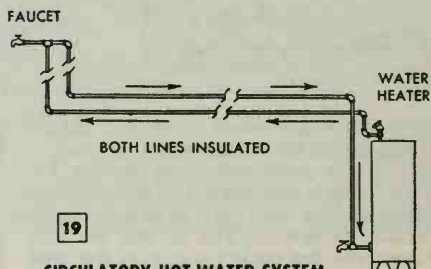
pipe as shown in Fig. 18. When installing an electric water heater, the piping is connected first, then the electrical connections are made while the main switch is turned off, after which the tank is filled with water and set into operation. It is best to consult your local electric company to check if your house wiring is adequate to take the additional load of an electric heater; also if you are in doubt about the wire size or the proper method of making the connections. Approved, sheathed cable can be used, or individual, insulated conductors can be run in metal conduit. A separate switch controlling the heater should be provided. Usually manufacturers supply complete wiring details.



16



HEAT TRAP IN HOT-WATER LINE



CIRCULATORY HOT-WATER SYSTEM

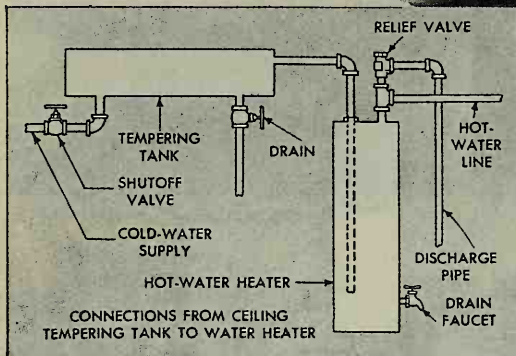
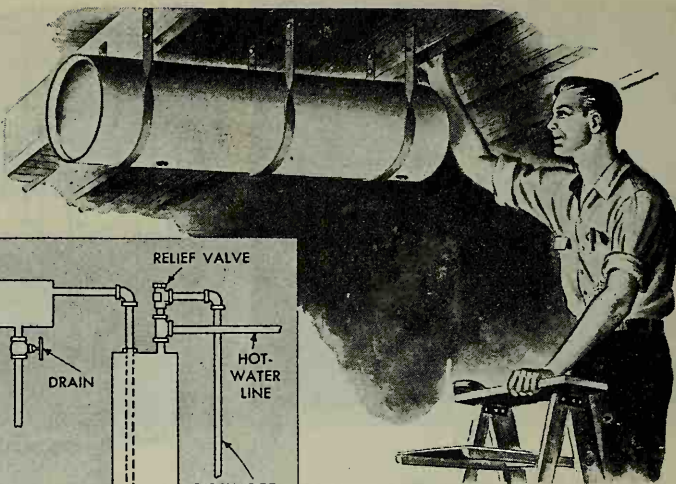
Safety controls: Every hot-water tank should be safeguarded against the possibility of explosion that can be caused by superheated water due to the failure of an automatic-heater cutoff, or forgetfulness in turning off a manually controlled heater. Few people realize that a single pound of water, flashed into steam under certain pressure and temperature conditions, can release 2,300,000 ft.-lb. of explosive energy. This is more than could be released by a pound of nitroglycerine, and it is more than enough to shatter a house.

A relief valve, preferably the type that is actuated by either pressure or temperature, should be installed in the hot-water line within 3 in. from the tank. See Figs. 14, 15 and 18. A shut-off valve should never be located between the tank and the relief valve. Temperature-relief valves usually have a fusible plug, which is easy to replace. The manual trip lever of a pressure-relief valve should be operated occasionally to see if the valve is working properly. Relief valves are not only needed on automatic water heaters but are just as important on manually ignited heaters,

which according to insurance-company records, produce the larger percentage of accidents. Be sure that a hot-water installation is properly inspected and approved by local authorities before it is put into service.

Heat losses from hot-water pipes: The shorter the pipes are from tank to outlets, the less heat will be lost by radiation, which may be considerable in long lines. Such heat loss makes it necessary to draw off large quantities of water before it becomes hot at the faucet. Over a gallon of cold water must be drawn from a 20-ft. length of $\frac{3}{4}$ -in. pipe when it is cold, to provide water at 120 deg. F. at the discharge end. Therefore, a water heater should be located as close as possible to the point where most hot water is used. Heat and water savings can be made by using $\frac{3}{8}$ -in. copper tubing, in lengths that will not cause excessive friction and consequent loss of water pressure at outlets. Small-diameter pipe increases the velocity of water flowing through it and may contribute to noise. Insulation on hot-water pipe is another effective method of saving on heat losses from pipe, sometimes as much as 30 percent.

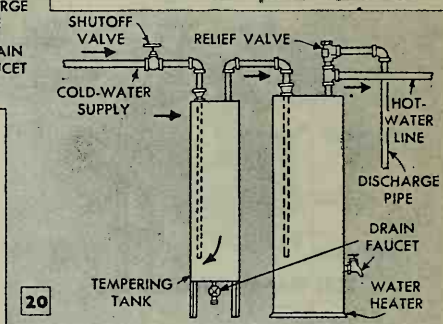
A TEMPERING TANK SAVES ON WATER-HEATING COSTS. SUCH TANKS ARE GENERALLY INSTALLED OVERHEAD, BEING HUNG FROM JOISTS WITH FLAT-IRON BANDS



Circulatory hot-water systems: Where long lengths of hot-water piping are necessary and the convenience of having hot water available quickly at distant outlets is more important than the cost of heat losses, a circulatory system, Fig. 19, can be used. This returns the cooled water to the tank and keeps hot water moving toward the outlet. Such pipes should be insulated to prevent needless waste of heat.

Tempering tanks: A saving in water-heating cost can be realized also by providing a tempering tank in which cold incoming water (sometimes only 40 deg. F.) is preheated to basement temperature before it goes to the water heater. Two arrangements are shown in Fig. 20. The tempering tank may be suspended horizontally from ceiling joists where air is the warmest, or the tank can be set up vertically. An old water-storage tank previously used with a side-arm heater, if in good condition, will serve nicely as a tempering tank. Any tank of 20 or 30-gal. capacity is generally sufficient. A tempering tank should never be insulated at this prevents the absorption of heat from the room. It should also be provided with a drain valve.

Tank draining and cleaning: Besides drawing a couple of gallons of water from the drain faucet of the water heater or tank every few weeks to clear out the sediment collecting at the bottom of the tank, an annual flushing also is advisable. To do this, shut off the heating unit and close the valve in the cold-water supply line. Open a hot-water faucet at a level above the tank. Then



drain the tank completely. Leave the drain faucet open and turn the valve in the cold-water line on completely so that the full force of the water will strike the bottom of the tank. This dislodges sediment that cannot be removed by gravity draining only. After such a flushing, close the drain faucet, open the cold-water valve and refill the tank and water line, after which the heater can be set in operation. When flushing a tank that is connected to a furnace coil, do not fill the tank until the coil is cool. This prevents it from cracking.

On an automatic gas or oil heater, the baffle of a center flueway should be removed occasionally so that both baffle and flueway can be cleaned, using a stiff-bristle flue brush. Replace the baffle with the same end down as it was originally. Such cleaning removes an accumulation of rust, dirt and soot which acts as insulation and retards transfer of heat through the tank wall.

Immersion-type elements in electric heaters are removable for cleaning off scale that may have accumulated on them. They should be inspected and cleaned at least once a year.



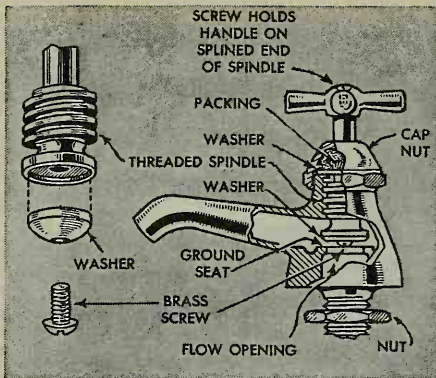
WATER PIPE

MOST WATER-SYSTEM TROUBLES can be prevented by proper servicing, such as keeping faucets and valves in good condition, renewing air in air chambers, protecting pipes against frost, and avoiding scale accumulations by water-softening equipment. Inherent troubles that are due to faulty installation may necessitate replacement of pipe and fittings. Substitution of larger pipe may also be necessary to take care of added demands.

Faucet noises: Chattering and whistling at faucets are among the most common noises. When this occurs with a compression-type faucet as shown in Fig. 1, look for a loose or defective internal assembly. Often the trouble is caused by a loose washer, which can produce chattering by alternately closing and freeing the water flow when turned on slightly. To remove the faucet spindle assembly, first turn off the water supply, then wrap the cap nut with cardboard or cloth to protect its finish when

loosening it with a suitable wrench—not a pipe wrench or pliers. Back off the cap nut entirely and unscrew the spindle assembly in the same direction as the handle turns when opening the faucet. Check the small screw holding the washer on the end of the spindle. If loose, tighten it so that the washer is seated firmly. If the washer is worn, replace it with a new one. When screwing the spindle assembly back into the faucet, carefully check whether there is any up-and-down play caused by wear on the threaded parts. If so, replace the spindle with a faucet insert.

Chattering and whistling noises may occur also in faucets and valves of poor hydraulic design, especially cheaper ones, due to a small, restricted waterway. When a water passage is restricted, the velocity of flow through the restricted passage is increased. When fast-moving water changes in direction, centrifugal force creates a vacuum at the inside of the turn and may

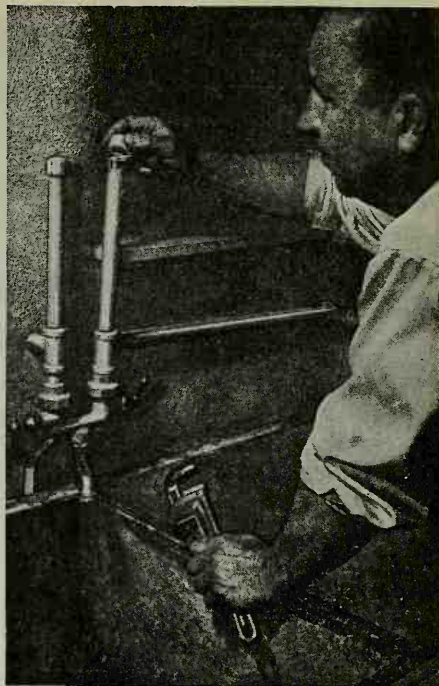


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cause vapor bubbles to form. When these collapse the vibration results in noise; if the vibration is of high frequency, whistling results; if of low frequency, chattering and pounding result. Where such noise in faucets and valves is inherent due to poor design, about the only remedy is to replace them.

Water hammer in pipes: Hammering noises in pipes that occur when a faucet or valve is closed suddenly are also extremely common. The momentum of fast-moving water in a pipe, particularly in a long horizontal pipe where water has considerable velocity, causes a shock wave when suddenly arrested. The shock wave travels back and forth between the faucet or valve and the point where the pipe changes direction or connects to a larger pipe or to a tank. The hammering that this causes can also shake the pipe violently. Such strain can result in rupture of the pipe at fittings, or the fittings themselves can crack. This is one reason why only malleable-iron fittings should be used on water pipes. Sometimes the noise is less pronounced when the pipe is anchored securely, but the same pressure is created by the shock wave and may still be injurious to the plumbing system although perhaps to a lesser extent. Water hammer is most pronounced when it occurs in hard, rigid pipe such as iron, steel or brass. It is less noticeable in flexible pipes such as copper, lead and especially plastic pipe, as it is very flexible and offers relief from pressure.

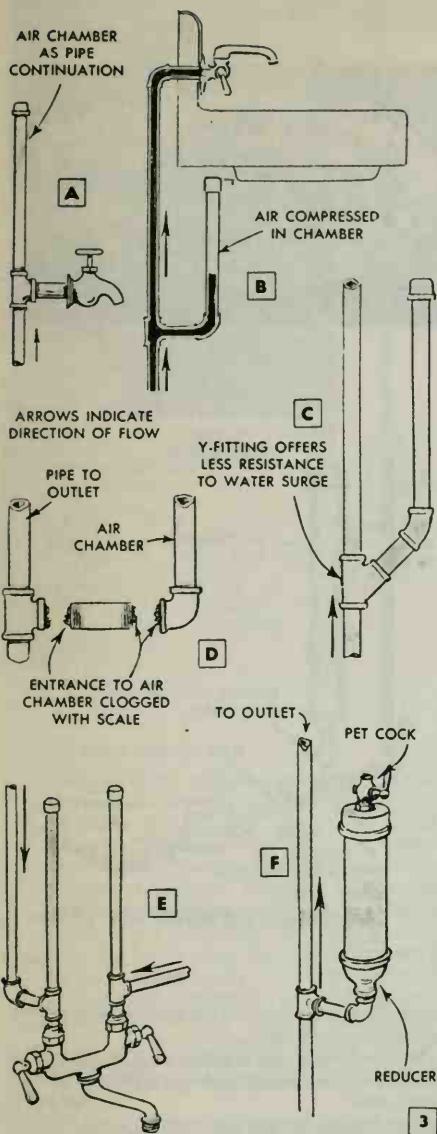
Since the trouble is occasioned by sudden



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closing of faucets and valves during the last 15 percent of the closing swing, it can be eliminated by closing them slowly. It cannot be prevented in quick-acting automatic valves generally, or in self-closing faucets. Any or all of the three following methods are used to reduce or eliminate water hammer: (1) Proper servicing of existing air chambers, or the installation of larger ones; (2) by using a pressure-reducing valve or regulator; (3) by providing braces to prevent pipe movement.

Servicing air chambers: In every well-designed plumbing system, air chambers are installed near outlets as in Figs. 2 and 3. The purpose is to provide a pressure relief. When faucets or valves are closed quickly, water rushes into the air chamber. As air is compressible it cushions the water thrust to a more gentle stop and thus causes less shock. However, since the air cushion is gradually absorbed by the water under pressure, more air must be provided periodically. This is done by draining out the water that replaces the air in a waterlogged air chamber as follows: First shut off the water supply to the air chamber at the nearest branch control valve, then open a drain valve below the level of the air chamber. If the air chamber is located above the faucet level as in the case with those



on basement laundry tubs, Fig. 2 and Fig. 3E, the faucet will serve as a drain. If the air chamber is accessible, remove the cap on the upper end to assure that water will run out—especially from small pipes which sometimes retain water unless it is so released. If there is any evidence of scale and corrosion in pipes, the air chambers should be removed occasionally to check whether they are open. Sometimes they become clogged, especially in short horizontal parts, detail D. When reassembling, wipe some pipe-joint compound or white

lead on the threaded ends of the pipe to assure air-tight joints, but avoid getting this inside of the fittings or it may taint the water. It may also start an obstruction. Repeat the process for both hot and cold-water outlets. If a pipe cap fits too loosely, wrap the threaded end of the pipe with a strand or two of cotton string or No. 40 cotton thread.

An air chamber that requires frequent attention can be made more convenient to drain by adding a petcock on the cap and a T-fitting with a plug or petcock at the bottom. Another method of servicing an air chamber is to install a tire valve on the cap so that air can be replenished by using a bicycle pump. When the supply of water to an individual faucet or valve can be shut off at a point close to the air chamber, you can remove the air chamber to drain it.

Air-chamber design: The capacity of an air chamber should not be less than 1 percent of the capacity of the pipe line in which water hammer occurs. For the average home, air chambers should not be less than 18 in. long. They should be made of 1-in. pipe when installed on $\frac{1}{2}$ -in. water lines, and of $1\frac{1}{4}$ -in. pipe when installed on $\frac{3}{4}$ -in. lines—two pipe sizes larger than the line. See Fig. 3F. Air chambers are set vertically; they may be a continuation of a riser as in detail A, or can be offset as in details B, C, E and F. Where possible, an air chamber arranged as a continuation of the pipe is best as it receives the full thrust of the water. For offset arrangements, 45-deg. fittings, as in detail C, offer less resistance to thrust than 90-deg. fittings. The direction of flow may be downward, as in detail E, but in all cases the opening to the air chamber is at its bottom. It has been found that the effectiveness of air chambers is measurably increased if the inlet opening is restricted to about one-half the internal diameter of the water pipe to which the air chamber is connected.

Pressure-relieving devices: There are also a number of commercially made shock absorbers which serve the same purpose as air chambers. Some of these have metal bellows; others, like the one in Fig. 4, have spring-loaded diaphragms. This type requires only a few inches of vertical space and is very convenient for use where overhead clearance is limited. Among the advantages of these shock absorbers are that they require much less space than air chambers and do not require periodic draining like the latter.

Location of air chambers and shock absorbers: Air chambers may be installed in partitions near the outlets they serve. They can also be located under the outlets, as in cabinets under kitchen sinks, or they may be located in an accessible position above outlets, as with faucets on basement laun-

dry tubs. Where water hammer occurs in the service line from street to house, a large air chamber, having provisions for venting and draining, should be located at the service-line entrance as shown in Fig. 5. When long, horizontal pipes require air chambers or shock absorbers these are installed at the end toward which water flows.

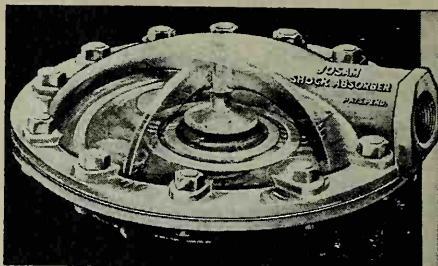
Pressure-reducing valves: Where water pressure is high, a pressure-reducing valve or pressure regulator to eliminate water hammer. By reducing the pressure, the velocity of water flow is slowed down and less shock is produced when faucets and valves are closed suddenly. If the trouble is not entirely cured by means of such a regulator, air chambers or pressure-relief devices may be installed also.

Pipe supports: Excessive lengthwise movement of long horizontal pipes can be avoided by supporting them firmly as shown in details A, B and C of Fig. 6. Such support does not in any way reduce the shock wave caused by closing faucets and valves suddenly, and therefore does not prevent possible injury to them. As the pipe is braced at the end toward which water flows, movement in the opposite direction due to expansion and contraction is not restricted.

Rattling of loose pipe against walls or joists can be prevented by proper support. Strap-type pipe hangers should be attached securely to the pipe; they can swing slightly to allow for pipe expansion. Pipe clips of the kind shown in detail D are used for supporting risers. They should not be used for attaching pipe to joists; then vibration is conducted to floors and noise is intensified. On concrete walls, pipe is attached at suitable points to blocks as shown.

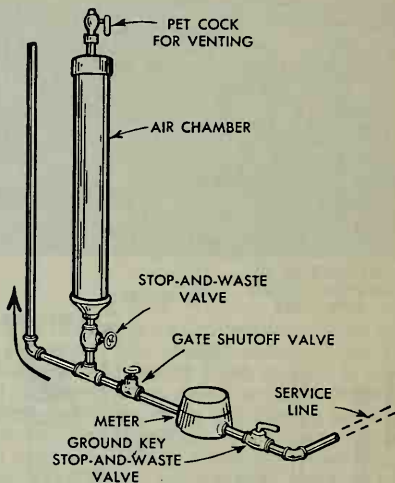
Noises from water heaters: Rumbling and pounding noises sometimes originate from water heaters or from the pipes between heaters and tanks. If a water heater is not properly protected by means of a safety-relief valve, or if the valve is not functioning, such noises may be caused by overheated water. The heater should be turned off at once and the relief valve checked. Some relief valves have test levers operated manually to make this check.

Noises in a water-heating system that is properly protected may also be due to poor circulation between the heater or furnace water back and the storage tank. Heavy liming of a heater coil or furnace water back, or the pipe from heater to storage tank, particularly at fittings, may restrict the circulation so much that steam pockets are formed. When these come in contact with the colder water of the tank, they collapse and cause hammering. The same can occur when a furnace coil is not



Josam Mfg. Co. photo

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AIR CHAMBER FOR SERVICE LINE

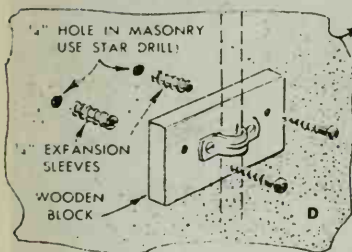
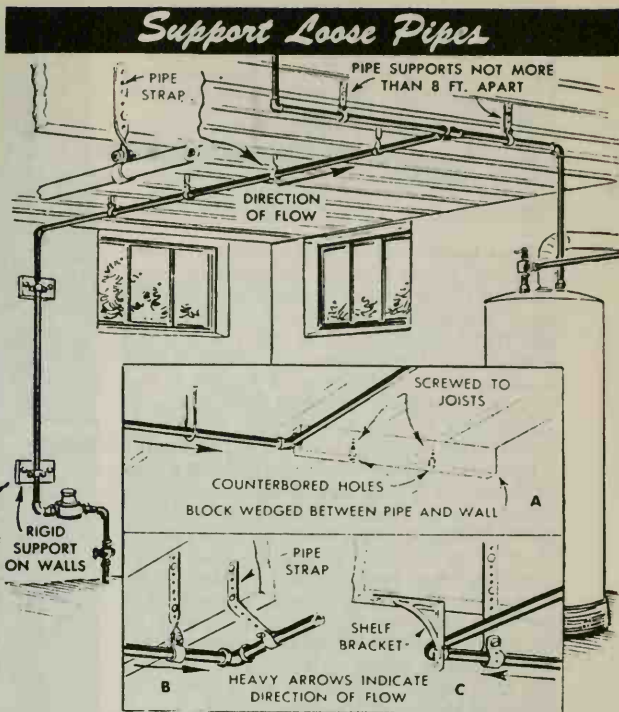
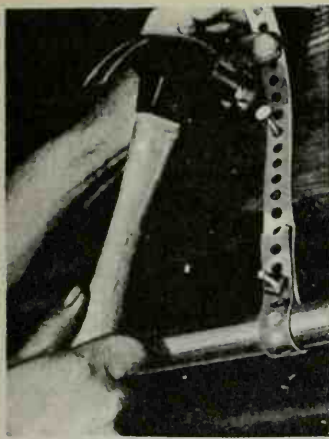
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level. This may loosen or break pipe joints and cause leakage.

Water-heater noises also can be traced to faulty pipe arrangements or pipe of insufficient size.

Usually water-heater noises are easy to avoid if unimpeded circulation of water is assured by proper connections, adequate pipe size and clean, internal surfaces in the heating coils and pipes. Also, the provision of an air chamber or shock absorber in the line from a water-heating coil to a storage tank will generally reduce the noise.

Water-closet noises: Many water closets emit a high-pitched noise that sometimes becomes a whistle when a flush tank is being filled. This originates at restricted passages in a float valve, particularly with



cheaper-type valves. Sometimes the condition can be remedied by proper adjustment of the valve. If not, the valve should be replaced with one that is more silent. If a float valve is provided with a backflow preventer or vacuum breaker, this sometimes causes a clicking sound. A low humming noise often indicates that water is running into the bowl after the tank has been filled, likely due to a leaky discharge valve. Usually the cause is a worn stopper ball but sometimes the seat is covered with grit or is pitted from corrosion. A new ball is the prescribed remedy, but the seat may also need cleaning and smoothing with emery cloth.

High-velocity noises in pipes: Whistling noises often are caused by high velocity of water flowing through pipes. The noise is produced when water flows around bends at high speed, the pressure at the inside of the turn being reduced by centrifugal force. The smaller the pipe is, the faster the water flows when submitted to the same pressure as in a larger pipe. Thus smaller pipes cause more noise than larger ones. Often the noise can be reduced or eliminated by simply wrapping the pipe, if accessible, with several layers of hair felt,

other sound-proofing material or by replacing the pipe with one of larger size. Floors and walls often act as sounding boards that intensify such noises. For this reason direct contact with a plastered wall, floor or joists under floors should be avoided.

Leaky faucets and water closets: Fig. 7 gives the cost of water leaks, which shows that it pays to prevent them. Leaks at faucets may be caused by a loose cap nut, worn packing in the nut, by a worn washer or washer seat. Water closets may develop leaks where the bowl connects to the soil pipe, usually indicated by water on the floor around this connection. The remedy consists of removing the bowl and resealing the joint. Another possible source of leaks may also occur between the tank and the bowl. They may be at the gasket between the tank and bowl if these are close-coupled or at the slip-joint elbow or sleeve between tank and bowl. Usually a new washer or gasket will cure the trouble. Another point where leakage may develop is at the joint between the float-valve stem and the tank, or at the point where it connects to the water-supply pipe.

SIZE OF LEAK STEADY DROP	CU. FT. PER DAY	COST PER YEAR AT		RATE PER 100 CU. FT.
• 1/16	3	\$2.16		
• 1/8	6	\$4.32	1st 10 M CU. FT.	18c
• 1/4	23	\$15.12	2nd 40 M CU. FT.	12c
• 3/8	93	\$60.48	OVER 50 M CU. FT.	9c
• 1/2	400			\$196.80

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Pipe leaks: When leaks develop at the threaded joints of pipe, the joint is either loose or the pipe may be fractured. Slightly loose joints often become sealed by scale and rust formation. If the leak persists and is located within a reasonable distance from a union, or from the end of a pipe, it can be unscrewed and examined. Sometimes re-assembling it after the threads have been coated with pipe-joint compound will make it leakproof. However, the threads on a pipe or those of a fitting may be defective or the fitting may be cracked and require replacement. Fractures from strain on pipes usually occur at the ends where the wall thickness has been reduced and weakened by threading, especially where threads have not been cut true. Strain on pipes may be caused by constant vibration or water hammer. Another cause of pipe leaks is freezing. Soft copper tubing can be subjected to repeated strains of freezing, enlarging each time, until it hardens and breaks. Flexible plastic pipe is not ruptured by freezing.

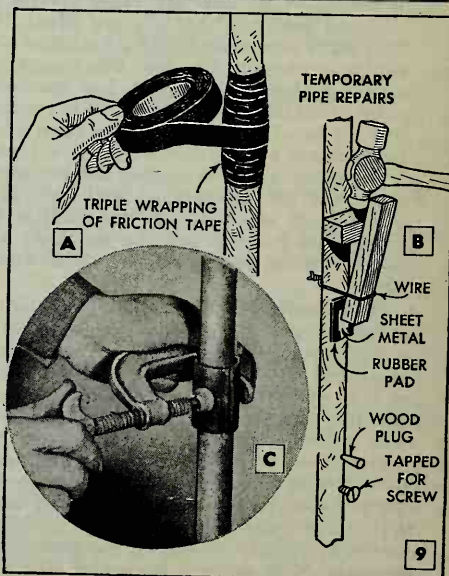
To repair a leaky pipe temporarily, you first shut off the water supply, then cut the pipe with a hacksaw on either side of the leak, after which a length of rubber hose or flexible plastic tubing is slipped over the ends as shown in Fig. 8, using hose clamps to tighten it securely. The inside diameter of the hose or tubing must be equal to the outside diameter of the pipe; 1-in. auto hose fits 3/4-in. pipe and 3/4-in. garden hose fits 1/2-in. pipe.

Other emergency repairs for leaky pipes are shown in details A, B and C of Fig. 9. Electrician's friction tape may be wrapped tightly around the pipe to 2 in. beyond the leak. The pressure may force water to leak between the pipe and the wrapping, but a slight drip is better than a spray.

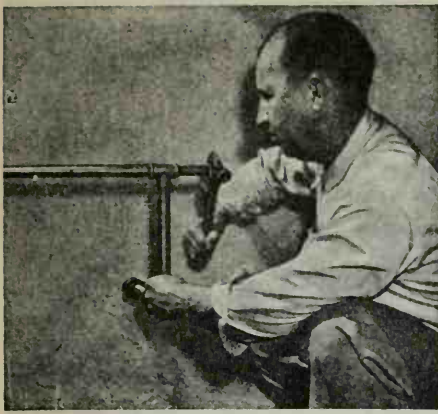
The best repair is a permanent one made with pipe as in Figs. 10 and 11. Cut the pipe with a hacksaw to permit unscrewing it, unless a union is located nearby. Saw the pipe not less than 4 in. from a fitting as in detail A of Fig. 11. Then unscrew the cut ends. The new section is made up of two lengths of pipe and a union, which, when assembled, should equal the length of the old pipe. A single length can be installed only when the old length was disconnected at a union as shown in detail B. Sim-



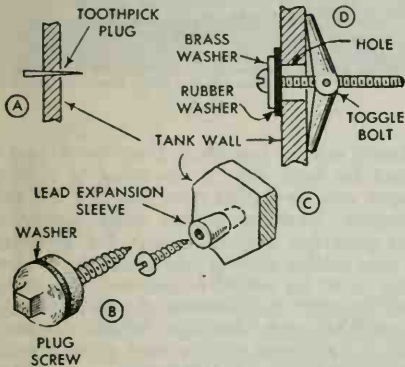
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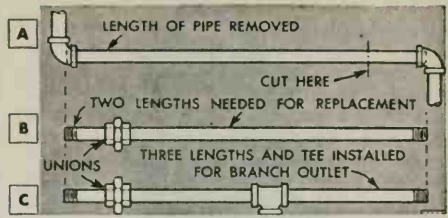


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ilar procedure is followed when it is desired to cut a branch line into an existing line as in detail C, except that a T-fitting is required between two new pipe lengths, which when assembled should equal the length of the cut pipe.

When a pipe leaks inside of a partition or under a floor, it is generally necessary to remove plaster or a portion of the floor (or ceiling below) to get at the pipe. In some cases a repair can be made by uncovering the leaky pipe at two accessible points near fittings. The pipe then is cut near the fittings, the stub ends are removed and adaptors are used for connecting copper tubing of proper size. Being flexible, copper tubing can often be installed inside partitions and floors through small openings. The old pipe is left in the partition or under the floor. Plastic pipe can be used instead of copper pipe if it is completely protected from rodents. Some kinds of plastic pipe in exposed locations are subject to rodent attack.

Leaks in tanks: Leaks in a hot-water tank



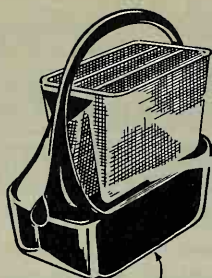
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generally indicate that the inside is badly corroded and weakened, in which case the tank should be replaced. However, an old tank sometimes can be kept in service until a new one is installed by making any of the temporary repairs shown in Fig. 12. If the tank is insulated, the outer covering and the insulation are removed to find and repair the leak. A pin-size leak often can be plugged by driving in the end of a round toothpick as in detail A. Swelling of the wood from its absorption of moisture will keep it in place. Larger leaks may be stopped by driving in a plug screw as in detail B. Another repair consists of drilling or reaming a hole to $\frac{1}{4}$ -in. size to admit a tapered lead expansion plug as in detail C. Driving a screw through the plug expands it. Still another repair method, detail D, is to enlarge the leak enough to permit inserting a toggle bolt to hold a brass-and-rubber washer assembly snugly against the leak on the outside of the tank.

Dripping from condensation: In many localities trouble is experienced from "sweating" pipes—condensation of moisture on the outside. The beads of moisture collect and drop off and may damage tools or other articles underneath such pipes. Normally, water inside a pipe or container warms up to room temperature, at which point condensation on the outside stops. In a plumbing system, cold-water pipes remain cold because water is continually drawn from them so that condensation continues. When this occurs between walls and floors, considerable damage may result to wallpaper and plaster as well as to structural members such as sills and studs, which may deteriorate from rot.

In basements, condensation troubles usually are experienced during the summer months. In closed basements, humidity can be minimized by means of a calcium-chloride drier, Fig. 13, or an electrically operated dehumidifier, Fig. 14. Besides preventing pipes from sweating such control also prevents condensation on cool floors and walls.

Condensation on cold-water pipes can be prevented by covering them with antidrip insulation, which is available in various forms. The pipes can be wrapped with a



CALCIUM-CHLORIDE
AIR DRIER

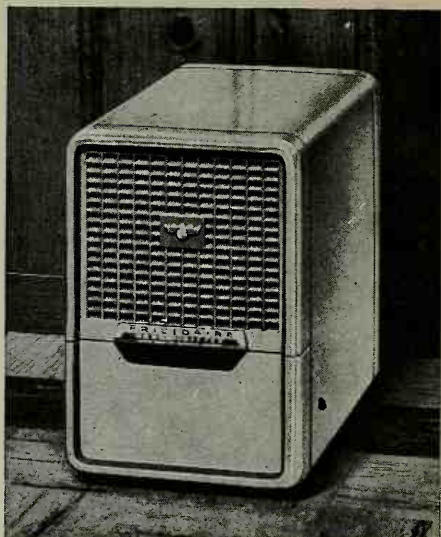
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thick tape containing ground cork as in Fig. 15, or coated with a thick plastic paint that contains cork granules, Fig. 16. Other coverings are tubular and split lengthwise for quick, easy attachment as shown in Fig. 19. These coverings may be air-cell asbestos, mineral or other wool. They are provided with a waterproof inner liner. Such insulation can be applied to exposed pipe, but hardly to pipe inside of partitions and floors without involving considerable cost and trouble unless installed when a house is being built.

Where much condensation forms on a water-closet tank and it drips on the floor, a tray like that in Fig. 17 can be attached under the tank. Trays on wall-hung tanks have a drain tube leading to the bowl; those on close-coupled tanks are provided with absorbent pads. Some tanks are made with an inner liner, such as shown in Fig. 18, which prevents them from being cooled by the water inside and thus prevents sweating. A water-tempering tank, which should never be insulated, can be provided with a drip pan if moisture on the basement floor is objectionable.

Protecting water pipes from frost: Where water pipes are exposed to low temperatures, they should be protected with insulation of suitable thickness; 1¼-in. felt covering generally is used. The covering must be continuous without any air gaps between adjoining lengths and must be carried over all pipe fittings. The pipe is first wrapped with tar paper, then covered with insulation which is wrapped with canvas as shown in Fig. 20A. Various types of tubular insulation can also be used, in which case the joints also are covered.

Installed pipe that will be exposed to weather must be properly protected. Where pipe is already installed, it may be enclosed with a water-tight wooden box, shown in Fig. 20B, in which case the space between the pipe and box is packed with sawdust, ground cork, mineral or other wool. The insulation between the pipe and the box



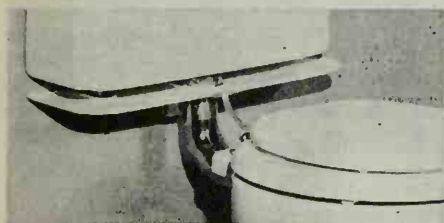
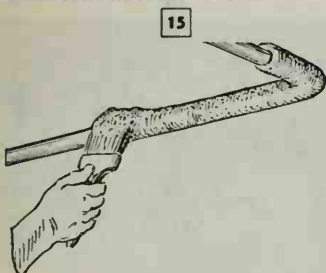
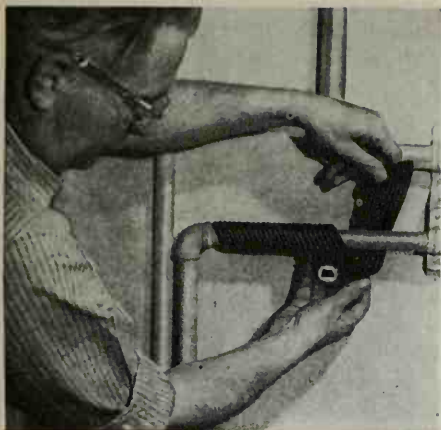
General Motors Corp., Frigidaire Div. photo

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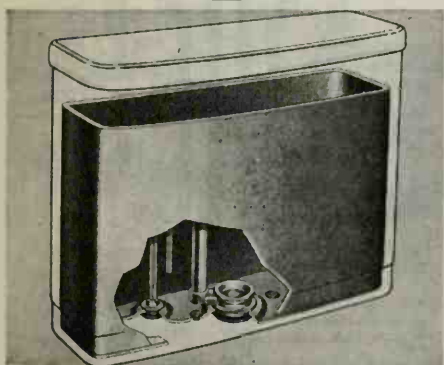
should not be less than 2 in. thick and it must be kept dry. A covering of roofing paper can be nailed over the box for this purpose. Sawdust makes good insulation but provides a good refuge for termites. It also settles after a while and more sawdust must be added occasionally to maintain its original thickness. Asphalt-impregnated fiber pipe, clay pipe, asbestos-cement and cement pipe can be used as an outside covering over insulation. An example of how an outside riser can be so protected is shown in Fig. 21. Underground piping should be laid below prevailing frost penetration. If this is not possible it should be covered with insulation protected against moisture.

Thawing frozen water pipes: Where electricity is available, the simplest method of thawing out a frozen pipe is by means of a pipe-thawing transformer such as used by many plumbers. While this method is quick, clean and relatively inexpensive, it is also hazardous if improperly done by novices. The clamps at the ends of two heavy cables are attached to the pipe on either side of the frozen section as shown in Fig. 22. An electric current flowing through the pipe between the clamps heats the pipe and melts the ice.

If such a pipe-thawing service is not available, and the frozen section of pipe is accessible, you can apply heat externally by holding an electric iron against the pipe or by placing an electric heater near it. However, when thawing a pipe by subjecting it to heat, never start at the middle of the



Laufenberg photo



Crane Co. photo

frozen section since the expansion of heated water confined by ice, or possibly the formation of steam, may burst the pipe. Start thawing on the faucet side of the obstruction and work toward the supply, keeping the faucet open so that you will know when the ice has melted. Be ready, however, to turn off the water supply in case the pipe has been ruptured.

Heat can also be applied in other ways. About the simplest method is to wrap the pipe with twisted rags or burlap to obtain a suitable thickness, and then keep the wrapping saturated with boiling water, as in Fig. 23. A blowtorch will give quick results where the pipe is accessible and not close to wood, paper or other combustible material. A sheet of asbestos board also can be used as a protective shield. Another method is to run boiling water inside the pipe if part of the pipe can be removed as in Fig. 24, or if you can start working from an outlet. For horizontal pipes you run the boiling water through a small pipe so that it flows against the ice, and the cooled water drains off into a pail. In vertical lengths of pipe you can use a rubber tube in the same way, keeping its end against the ice. A jet of steam works still faster.

Scale and corrosion: Scale and corrosion on the inside of water pipes generally cause most damage to plumbing systems, since the pipes may become completely clogged. The rate at which scale and corrosion form varies with the chemical properties of the water and also its temperature. Scale forms faster on the rough surface of galvanized-iron pipe than it does on the smooth surface of brass pipe and copper tubing. It also forms faster wherever there is resistance to the flow of water as at elbows, tees and other fittings. Hard water causing scale formation can be recognized as such by its inability to form suds and lather easily. When hard water is artificially softened, the calcium and magnesium compounds are removed.

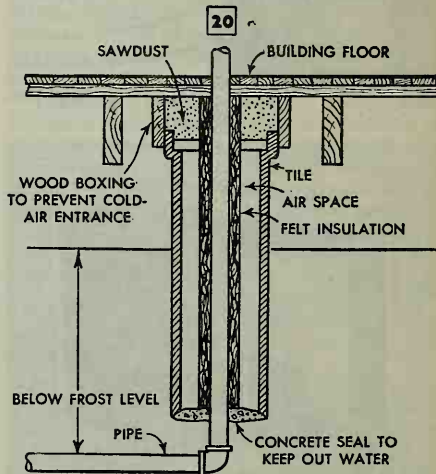
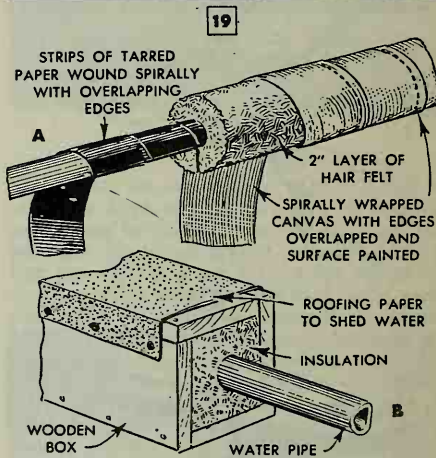
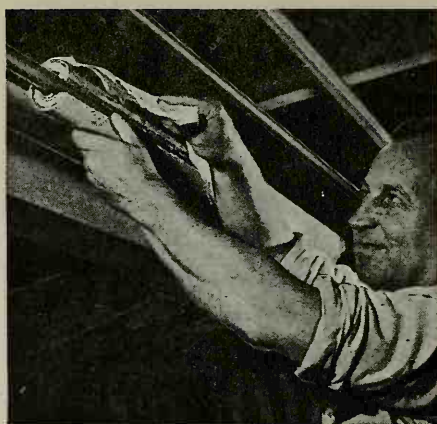
Hard water is not as corrosive as natural soft water containing free carbon dioxide. A 40-deg. temperature rise in water about doubles its corrosive action and also hastens scale formation. Therefore, the life of hot-water pipes is considerably less than that of cold-water pipes. Rust "grows" to more than 10 times the volume of the iron from which it forms and this alone clogs pipes. Enough rust often is released in pipes to discolor the water and stain fabrics. Corrosiveness of water can be reduced considerably by removing the carbon-dioxide gas.

Clogged pipes and heater coils: When the flow of water from faucets becomes much less than it was when the pipes were new, the inside is probably caked with scale and

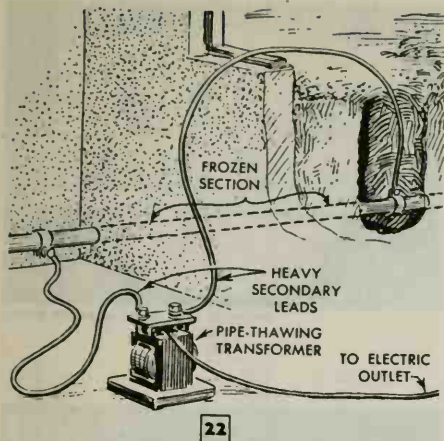
corrosion. Replacement of the fittings alone may restore a satisfactory water flow for some time if the pipes themselves are not heavily caked. If badly caked, they should be replaced. Copper pipe and tubing are less subject to corrosion than iron and steel pipe; plastic pipe is not affected by corrosion but cannot be used for hot-water lines.

When it takes a long time for water to heat, the trouble may be caused by scale and corrosion accumulations in a heating coil or furnace water back in the pipes connecting these coils to hot-water tanks. The scale acts as insulation, preventing maximum heat transfer and consequently much time and heat are required to heat the water. As soon as such sluggish results are noticed in a coil water heater or water back, remove and inspect it. Generally badly caked coils and water backs must be replaced; although if the scale is caused by limestone, it can be softened and removed by using a muriatic-acid solution. This consists of muriatic acid, 1 part, slowly added and stirred into water, 4 to 7 parts, depending on the thickness of the scale. The mixing of the solution is done in a glass or porcelain container. Be careful not to get the acid on the skin or clothes as it causes burns and is corrosive and poisonous. To use the solution, close the lower opening of the coil, pour the solution into it and let it stand for a period of 4 to 6 hrs. Then pour out the solution and flush the coil with water to remove all traces of the acid. If one treatment does not remove the deposit, repeat as many times as is necessary. Deposits other than limestone, as for instance gypsum, are not appreciably affected by this solution. When a limestone-caked pipe is located in a wall or other place where it cannot be removed easily for replacement without considerable damage, the acid treatment can be tried.

Frost precautions in closed house: When a house is closed during cold weather and is not heated, the water system must be drained completely to prevent damage from freezing. First shut off the water supply at the main control valve near the meter, and turn off the heat source of the water heater. Then open the drain valve at the lowest point of the piping and also open all faucets so that water will flow out more easily. Also open the drain faucet on the water heater, and if it has a heat trap, water must be removed from this also. For this reason a drain valve should be provided at the lower point of the trap. Empty water-closet tanks by flushing. If the system includes water-softening or conditioning equipment, or any tanks for water storage, these too must be emptied completely. It also is advisable to have the water service turned off at the curb valve and to have the water



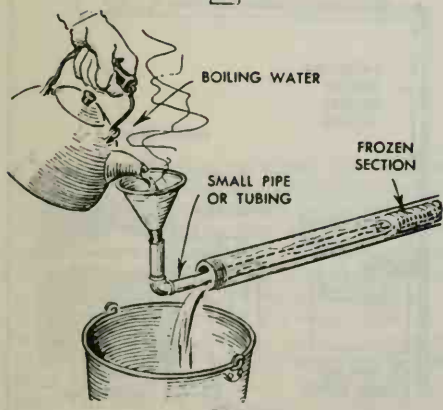
21 FROST PROTECTION FOR A COLD-WATER RISER BETWEEN GROUND AND FLOOR
Tennessee Valley Authority illustration.



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meter removed. If this is not done the exposed part of the service pipe and meter should be carefully insulated to prevent water inside from freezing. Water in heating systems and traps of the drainage system, including water-closet traps, must be removed also. Kerosene is substituted for water in traps.

Water-pressure troubles: One of the most common complaints of home water supplies is variation of water pressure; for example, a running mixture of hot and cold water at a shower or bath suddenly varies in volume of flow and temperature due to drawing water from another outlet. Such variations often cause discomforts and may even result in injury when the water mixture becomes scalding. Where such trouble is constant and frequent, the water pipes may be too small—either of inadequate diameter as originally installed, or their diameter may have been reduced by liming and corrosion. Another cause of inadequate pressure and water flow is excessive friction in the pipe due to too many fittings and changes of direction. Or, piping originally adequate may have become overloaded by an extra bathroom or automatic washing equipment.

When variations of pressure at shower and bath outlets only occur when other outlets are opened, the situation can be remedied usually by installing automatic mixing valves. This, however, does not increase the water flow from an inadequately sized pipe, which can be done only by replacing the pipe with one of larger size. Replacement of pipe also is necessary where water pressure is inadequate at outlets but is sufficient at the service-line entrance.

Temporary low pressure can be occasioned by large amounts of water being drawn off the city mains in the neighborhood, as for instance by fire equipment, but this trouble is only temporary. A pressure gauge at the meter location will show whether continued low pressure at outlets is caused by pipe resistance inside of the house or whether the fault lies outside. It can be occasioned by a service pipe that is clogged or is of too small diameter. This is likely to be the case if the pressure at the curb valve is much higher than that at the house entrance of the service pipe. A clogged service pipe can be cleared by using a drain auger (new or sterilized). When pressure at the curb valve is not much higher than that of the house end of the service line, the fault may be an obstruction between the curb valve and the city water main, or the pressure of the latter may be insufficient. Where water pressures are too high, which may cause water hammer and

whistling noises, the pressure can be reduced by using a pressure-reducing valve.

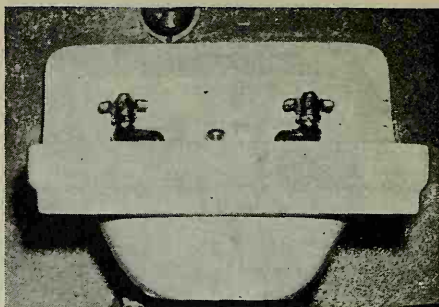
Hazards of cross connections and backflow: Polluted water from a drainage system may get into the water-supply lines under certain conditions. This has caused numerous epidemics such as the amoebic dysentery in Chicago during 1933. Germs causing typhoid fever and other diseases, once inside the water pipes, can spread to all parts of the system. Chlorinated water used in many cities kills all known water-borne germs except the one causing amoebic dysentery; this one is able to survive about 15 days in chlorinated water.

When a water-supply outlet is located below the flood-level rim of a fixture, the outlet will be submerged when the fixture is filled. Then a cross connection exists between the drainage and the water-supply lines. This is especially likely to occur with obsolete fixtures such as shown in Figs. 25 and 26. When a water-supply outlet is submerged, the contents of drainage lines can be sucked into the water line. This happens when pressure in the water line is decreased below atmospheric pressure and may be occasioned when a large quantity of water is drawn off at a lower point in the house as illustrated in Fig. 27. The polluted water can even seep through a closed faucet if it is leaky, or it can be drawn up through a spray nozzle submerged in a bathtub or kitchen sink. This reverse flow is called back-siphonage or backflow. It is especially likely to occur when a lower water-supply branch is much larger than necessary. It can also be caused by a broken water main or a heavy draw from the water main by fire apparatus. Draining water from a basement or first-floor outlet while the main supply line is shut off causes backflow from points above.

Backflow is particularly common in downfeed water systems—those having an overhead supply tank from which water flows down to fixtures. It can occur also in any upfeed system—water supplied from city main or pressure tank below fixtures. Fig. 28 shows a number of fixtures used in and around homes where cross connections can exist and similar fixtures (on right) where the trouble is eliminated.

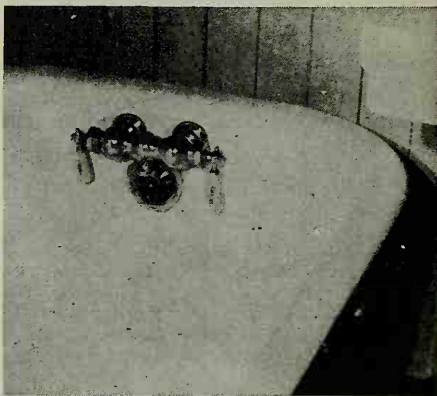
Preventing cross-connections: Cross connections and backflow can be eliminated as follows: (1) by providing a suitable air gap between the outlet and the flood-level rim of a fixture (where this is impossible an approved type of backflow preventer or vacuum breaker should be used), and (2) by assuring a positive water pressure at all outlets at all times.

Air gaps, as shown in Fig. 29, should not be less than 1 in. for a lavatory, 1½ in. for a kitchen sink or laundry tub, and 2 in. for

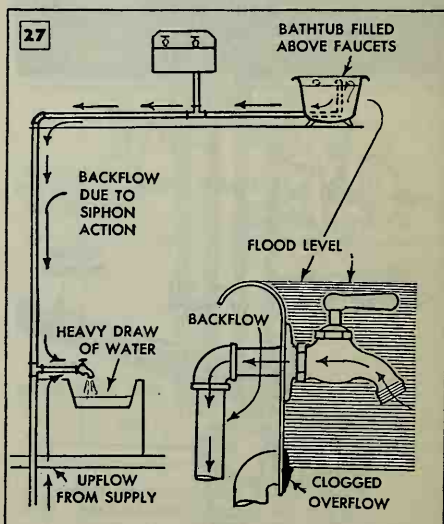


Minnesota State Board of Health photos

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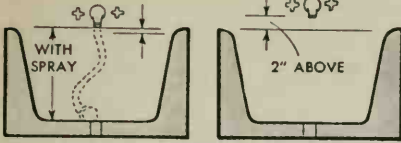
26



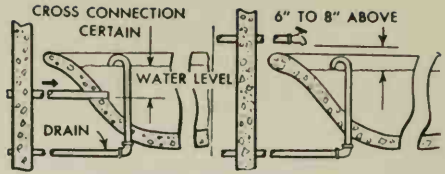
CROSS CONNECTIONS
POSSIBLE

28

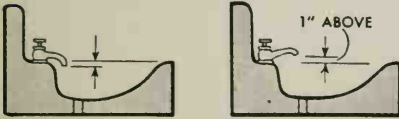
AIR GAPS PREVENT
CROSS CONNECTIONS



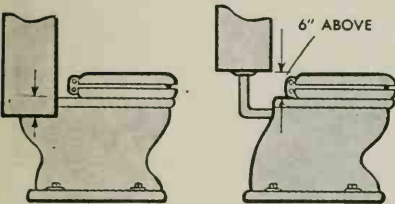
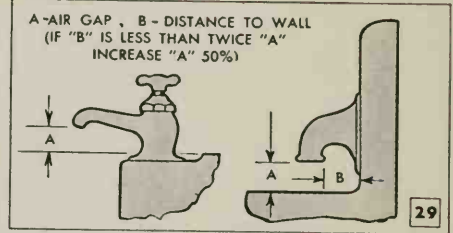
BATH TUBS



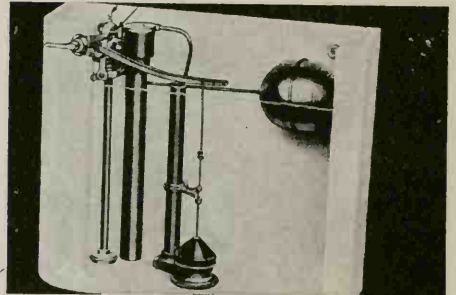
GARDEN AND SWIMMING POOLS



LAVATORIES



WATER CLOSETS



Kohler Co. photo

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a bathtub. If outlets are closer to a vertical wall than twice these distances, the normal air gap in each case should be increased 50 percent. Old fixtures often can be altered to meet these requirements. A backflow preventer is installed on the discharge side of a valve controlling the water supply to a fixture, as for example the float valve of a water-closet tank. Here a cross connection often exists since the valve is frequently submerged. Usually there is no pollution from the water in the tank, but this is pos-

sible if the tank outlet is located below the flood-level rim of the bowl. Safety is assured by installing a float valve equipped with a backflow preventer as shown in Fig. 30. A private water-supply system should never be interconnected with piping that supplies water from a city main. Nor should rainwater pipes be connected to pipes conveying drinking water. Both should be conveyed through separate pipes, and those not carrying drinking water should be clearly identified with yellow paint.





